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SCIENTIFIC MANAGEMENT FOR RUBBER MANUFACTURERS

Introduction

A Consideration of the Causes Behind the Development of Scientific Management and of the Economic Forces Which Demand Serious Study

By Alfred Baruch

Consulting Industrial Engineer, New York

IT is the object of this and other articles to appear in subsequent issues of THE RUBBER AGE to treat in a comprehensive manner the subject of scientific management in rubber factories. The purpose of this work is two-fold: First, to establish the need of scientific methods in the management of rubber factories; and second, to provide rubber producers with a detailed system that will conform in principle to the latest developments in scientific management, and yet meet the practical requirements that are peculiar to the rubber trade.

In the days before the industrial revolution a man who owned a spinning wheel and a hand loom was usually able to produce more cloth than he needed for his own immediate use and this excess he would sell in the town to those in need of his products. This method of direct barter constituted the entire production scheme. Each man engaged in this work was at once a capitalist, a salesman and a producer.

The Effect of the Industrial Revolution

With the coming of the industrial revolution and the gradual substitution of machinery for hand manufacture, it became impossible for one man to furnish the funds required to conduct a business on a large scale, to perform all the labor necessary, and then to go out and sell the product. Consequently, there came into existence the capitalist, the sales manager, and the production manager. With the ever increasing scope of manufacturing enterprise, each one of the three have become more and more specialized in their own respective fields and have tended to leave the other activities to someone else. Necessarily, each group has developed a complicated technique to a point where it is possible to treat with only one subject at a time, if one hopes to do more than indulge in glib generalities. Therefore, though there is a science of management in financing business enterprises and in selling, we will restrict the following discussion to production problems alone.

Production as an Economic Factor

Production is the backbone of industry. In one form or another it has always been the means by which man obtained the necessities and even the pleasures of life. There is no conceivable scheme of industrial or social organization which can eliminate production, although several ideas have been advanced which would do away with the necessity of the other two elements of modern enterprise. For a long time, the feeling prevailed among business men that production was of secondary importance to financing and selling. Bankers will often show more confidence in an enterprise headed by financial men than in one headed by technicians, on the theory that if the financial organization is correct the rest will take care of itself; sales managers will say that it is the sales that really produce the revenue and should therefore get the first consideration. As a matter of fact, all three elements are important. But if a business is on an efficient production basis, so that it can sell as low or lower than its competitors and still make money, the financial arrangements can easily be made and the sales will practically take care of themselves. It is production, then, that needs to be most thoroughly studied and whose fundamental principles must be carefully observed.

There is probably no other phase of business enterprise, the importance of which has been emphasized as much in recent years as that of management. The chief functions of factory management are planning and fabrication. These ends are accomplished through a division of labor, which is the essential characteristic of management; this assigns all of the planning to one group and all of the fabrication to another, so that the maximum results of productive effort may be obtained.

Scientific Management

This brings us to the development of modern scientific management. In former years it was customary to refer with great pride to the common sense of the practical shop man. Let the engineers develop the necessary machinery and the common sense of the shop foreman would see to it that the best results were obtained. The procedure for getting these results never varied. The foreman would try one method, if that failed he would try a second, and a third, until he finally found out what he wanted. Although this means of developing shop practice was unsatisfactory, it was the common belief that no other method existed or could be devised and the cost of these experiments was simply looked upon as part of the expense of production. However, it was a practical shop man who was the first to discover that blundering through was not the only way of developing production technique.

In 1895 F. W. Taylor outlined for the first time the principles of scientific management in a paper read before the American Society of Mechanical Engineers. Mr. Taylor at that time was in charge of production at the Bethlehem Steel Co. and his paper was the result of an exhaustive analysis of the problems of management, the solution of which he finally formulated into a science and applied in a practical way before he published his results. Of Mr. Taylor's methods we shall have more to say in the chapter on organization, but below are the principles which he laid down as the basis for scientific management as opposed to the common sense management as described above.

1. The development of a science of each element of a man's work, thereby replacing the old rule-of-thumb method.
2. The selection of the best worker for each particular task and then training, teaching, and developing the workman, in place of the former practice of allowing the worker to select his own task and train himself as best he could.
3. The development of the spirit of hearty co-operation between the management and the men in carrying on the activities in accordance with the principles of the developed science.
4. The division of the work in almost equal shares between the management and the worker, each department taking over the work for which it is best fitted instead of the former condition in which almost all of the work and the greater part of the responsibility was thrown on the men.

The greatest difficulty experienced by engineers in evolving systems of scientific management is that the production managers themselves do not enter into the project completely enough to insure its success. A notable exception to this rule is Lieutenant-Colonel George D. Babcock, who was formerly the production manager of the Franklin Manufacturing Co. Colonel Babcock not only installed a complete system of scientific management in the Franklin plant, but he has written a book in which he gives a detailed account of the methods and their results. In attempting to define scientific management, therefore, one could not do better than to quote him. In the third chapter of his book he says: "Scientific management is essentially a system of classification and standardization. It is that kind of management which conducts a business or affairs by standards established by facts or truths gained through systematic observation, experiments, or reasoning.

"It is quite different from common sense management which relied upon native practical intelligence, natural prudence, tact, and behavior, and a generally accepted attribute of good management in that it is based upon acquired learning and logical speculation. The virtues of the older system are not discarded nor in any sense discounted in the scientific management. They are, on the other hand, incorporated and assimilated co-ordinately with the acquired and carefully investigated knowledge to form a comprehensive system of co-operation between management and producer. Careful and systematic classification and standardization of methods, materials, tools, and products form, therefore, the first requisite for the installation of scientific management."

Thus, it may be readily seen that science must be applied to management as well as to the design of machinery. The most casual investigation of the functions of management will reveal the truth of this statement.

The Functions of Management

The management is responsible for the construction of the factory building. It must purchase and properly arrange the mechanical equipment. It must purchase the necessary material in such quantities and at such times as will incur the least possible expense for the factory, and yet keep it sufficiently supplied with material so that there is no delay. It must design the product and schedule its fabrication. It must select, train and supervise the labor and then inspect the results of its efforts. It must maintain the plant and the equipment in a state of good repair. It must store the products in the various stages of completion and give a due accounting of all expenditures.

In the days before the industrial revolution when all the elements of productive organization were contained in one man these problems were of minor importance or else they did not exist at all. In these days of complicated production by factories employing hundreds and even thousands of men and selling many varieties of products, the development of a true science of management becomes imperative.

The obvious purpose of the introduction of science in management is to get more output in proportion to the effort. It is a form of intensive utilization of equipment. It differs from the common sense type of management in about the same way that intensive farming is different from extensive farming. A man begins by farming extensively, as we did in the United States. This was due to the fact that the soil was rich and the land was cheap. Population was scarce and therefore did not crowd the soil. In Europe, however, where the population is denser and the land much more valuable in proportion, every farmer has to cultivate a smaller plot intensively so as to get the maximum return possible for his efforts.

The first step toward increasing returns is the development of a unit of measure, by means of which the output can be gaged daily in proportion to the effort. The name generally given to this process of developing a unit of measure is called standardization. Standardization covers every element of porduction. It is possible to standardize material, methods, machinery, products and costs.

The Importance of Standardization

Fortunately for the rubber industry the standardization of the bulk of its products, namely, tires and tubes, has already been accomplished. But materials, methods, machinery, and costs are far from standardized and therefore present the industry with a vast problem, the solution of which will mean the saving of many millions of dollars.

As has already been pointed out the standardization of tires and tubes is an actual accomplishment. However, when we consider other rubber products, such as hose, insulation, and the various hard rubber commodities used for telephone, telegraph, wireless, and now the radio, we find standardization of these products is yet to be accomplished. Due to the mystery which enshrouds the compound room, the standardization of material seems a hopeless task whose difficulties are not lessened by the great variety and multiplicity of sources of raw and plantation rubber.

The standardization of methods is almost as difficult in most shops, since the question of method is left to the foreman of each department to decide and, under the plea that each case is different, most foremen will refuse to set their experiences down on paper or to answer questions that will permit anyone else to do so. However, in every other field that has been investigated, foremen have shown the same reluctance to part with any information that might lessen the dependence on them of the factory in which they are working. But with the exercise of a great deal of patience these men can be taught that new methods will further their own interests, as well as those of the company for which they work, and when they come to see the truth of this they become the surest and safest protection against the system's failing for lack of effort.

Machinery is also very poorly standardized. Although the types of machinery, such as light- and heavy-duty mills, are fairly well-defined, there is no standardization of gearing and of speed and gage enabling the development of serviceable data from the action of the various machines and thus govern the regulation of production and maintenance costs accordingly.

Costs in rubber factories are in almost complete chaos. In most cases, costs are entirely on an estimate basis. This is a fair enough method if a factory restricts itself to the production of tires and tubes only, and if it prepares the tube stock on different mills and calenders than those used in the preparation of the tire stock. But where a factory produces mechanical rubbers as well, or else restricts its output to mechanical rubbers, standardization of costs is essential to good management.

The Development of Rubber Manufacturing

In order to understand more thoroughly the causes for this lack of standards and system, it is necessary to go back into the development of the rubber industry. Although the way to vulcanize rubber was discovered nearly 100 years ago and rubber was thus made a serviceable commodity, the industry did not expand to any considerable proportions until the development of the automobile about 20 years ago. Since that time rubber manufacturing has come forward by leaps and bounds until it took its place during the war as one of the five or six leading industries of the world.

In spite of this very recent development, the rubber producers did not take advantage of the experience of other

great enterprises. Consequently, the same evils that attended the industrial revolution in all fields soon appeared in this industry as well.

The reasons for this are not difficult to find. Practically all of the rubber shops of today started small. The owners never dreamed of the tremendous expansion of the industry and consequently made no provision for it, with the result that when business expanded and outgrew the small plant which housed the factory, the owners were forced to increase their capacity.

The additions were usually based on convenience or necessity and not upon a scientific determination of the proper expansion of the factory. Furthermore, in laying it out, little thought was given to the logical arrangement of equipment so as to avoid unnecessary steps. As additional machines were bought it was natural that they should be placed near similar machines. The factory thus grew along definite lines and split up into departments which became so firmly established in their respective sections that a rearrangement of the equipment along scientific lines would prove a costly undertaking.

When the factory was small it was naturally easy for one man to control all of the activities within one department, or even of the whole plant. As it grew in proportion this became more and more difficult to do, but men are naturally reluctant to release or even to delegate any authority that they have once acquired. This may not be due to selfishness. A man who has watched an organization grow from the infant stage to the strength of a man is under the impression, and often with a great deal of justification, that he knows more of the details concerning that particular plant than anyone else. Consequently, he is prone to interfere with his subordinates instead of waiting for these people to make the mistakes and then correct them. The result of this interference with delegated authority is often a source of friction among employes and always tends to retard production because employes in that case are much more likely to cater to the wishes of their eccentric superiors than to follow the dictates of their reason and their experience.

The burden of planning and controlling production is often put on the shoulders of these same foremen and superintendents. It was natural for these men to perform such duties at first but they were not relieved of them when the factory grew in size. The result of letting the foreman of an individual department plan and control the production in his department is exactly the same as the effect of letting train dispatchers at way stations determine the best time for the passing trains to start and stop. The result of this haphazard management is that material is not properly guarded in storage, labor is not trained and directed so as to produce the maximum results, and general waste creeps into the overhead because there is no watch kept over the cost. Ignorance as to cost is probably the greatest evil of them all.

The Scope of Scientific Management

The remedy for these evils lies in the introduction of scientific management. It is our plan, therefore, to furnish the rubber industry with a comprehensive system of scientific management in the articles which are to follow this one. The scope of this system is indicated in the following outline:

1. Organization.
   - (a) The mechanical layout of the plant with a view to reducing lost motion and the necessity for excessive transportation between departments.
   - (b) The proper division of authority and responsibility between the major and minor executives.
   - (c) Standardization of material, product, machinery, methods and costs.
   - (d) The planning and dispatching of production.
2. Material Control.
   - (a) Purchasing, receiving, and inspection.
   - (b) Storage in stock rooms and production centers.
   - (c) Perpetual inventory of raw material and finished stock.
   - (d) Material charges and requisitions.
3. Labor.
   - (a) Production standards.
   - (b) Wages and incentives.
   - (c) Sanitation.
   - (d) Industrial relations.
4. Maintenance.
   - (a) Machinery and equipment.
   - (b) Small tools and accessories.
   - (c) Transmission.
5. Costs.
   - (a) Labor and material.
   - (b) Shop burden.
   - (c) Interest on shop investment and the reserve for depreciation.
   - (d) The application of burden.
   - (e) Selling and administrative expenses.
   - (f) Cost comparisons.
   - (g) Monthly statements of profit and loss.
   - (h) The predetermination of unit costs.

Regarding the Use of Magnesia in the Rubber Industry

A Letter to The Editor from H. W. Greider, Industrial Fellow at the Mellon Institute of Industrial Research of the University of Pittsburgh

May 17, 1922.

To The Editor, The Rubber Age:

I should like to make a few comments on the article by A. H. Smith, entitled "The Use of Magnesia in the Rubber Industry," which has just appeared in the May 10 issue of your journal. I shall not attempt to criticize any of the remarks relating to calcined magnesia, but since we have made light magnesium carbonate the subject of a rather extensive investigation at the Mellon Institute of Industrial Research, for the Magnesia Association of America, I ask the privilege of making a few comments and additions to Mr. Smith's statements regarding that material and hope that you can find space for this letter in the columns of your journal. While I feel sure that it was Mr. Smith's intention only to discuss certain facts regarding magnesia from his own experience with that material, some of the statements he has made would be subject to quite serious misinterpretation on the part of the casual reader unfamiliar with the material.

There are three varieties of the magnesium carbonate offered to the rubber industry of this country. The first and cheapest is ground magnesite, which is nothing more than the pulverized natural rock, containing silica, alumina and other impurities sometimes to as great an extent as 10 per cent. This material is very coarse and has no reinforcing effect in rubber, being a physically inert filler in no way superior to chalk, talc or other cheap fillers. It has no accelerating action on the cure. A coarse and cheap grade of magnesium oxide for use as an accelerator is manufactured from this material by simply calcining and pulverizing it. This is the ordinary heavy calcined magnesia.

The second grade of magnesium carbonate and a better grade is the product made by treating a solution of a soluble magnesium salt with an alkali carbonate. The composition and fineness of division of this material is quite variable, depending on the conditions of its manufacture, and it is not a very dependable material for the rubber manufacturer, because of these variations. It may or may not be a reinforcing

pigment, depending upon the care with which it has been prepared to give a small particle size. Mr. Smith's statement regarding the differences in material precipitated from hot and from cold solutions applies to this variety of magnesium carbonate.

The third variety, and the one of greatest value to the rubber manufacturer, is prepared from dolomite rock by a complicated chemical process and results in a very finely divided form from the rapid heating under rigidly controlled conditions of a solution of magnesium bicarbonate. This modern method of manufacture is the one in use today by most American manufacturers of light magnesium carbonate and gives a product of uniform chemical composition and extremely fine particle size. This material is a typical rubber reinforcing pigment and its reinforcing effect is evidently due, as in the cases of all other reinforcing pigments, to the combined effect of two factors—(1) extremely small particle size, and (2) a specific cohesion effect between the pigment particles and the rubber matrix. Mr. Smith's reference to the relative coarseness of particles of magnesium carbonate certainly cannot refer to this variety of magnesium carbonate, since when examined under the microscope in the dry state or dispersed in rubber, it is seen that most of the particles have an average diameter considerably less than one micron, although there are always a few larger crystals distributed in the field. Due to these few larger particles the *average* particle size is somewhat greater than that of the best grades of zinc oxide, but some of the grades of zinc oxide commonly used in the rubber industry have apparently a *larger* particle size than technical light magnesium carbonate. Compared with gas black, it is quite true that light magnesium carbonate is *relatively* coarse, but with respect to the other reinforcing pigments used in rubber, such as zinc oxide, china clay and colloidal barium sulphate, this is certainly not the case.

Light magnesium carbonate does, indeed, have no pigmenting power for whiteness in rubber, but this is due, *not* to its "relative coarseness of particle," but to the fact that the index of refraction of the magnesium carbonate particles is almost identical with that of the rubber in which they are imbedded. This same property is also made use of when light magnesium carbonate is incorporated in varnishes to raise their viscosity and body, likewise in lithographic printing inks.

Light magnesium carbonate does produce a very marked increase in the tensile strength of rubber compounded with it when not used in excessive amounts as has been shown in an article published in the February 10 issue of THE RUBBER AGE, and a detailed paper which has just appeared in the May issue of the *Journal of Industrial and Engineering Chemistry*. In fact, light magnesium carbonate is not exceeded in its reinforcing power by any commonly used rubber pigment except gas black, as is shown by the fact that when used in suitable proportions it increases the tensile strength, hardness, rigidity, toughness and resilient energy to a greater extent than does zinc oxide, china clay, colloidal barium sulphate or lithopone. Magnesium carbonate also gives the compounds in which it is used a greatly increased resistance to abrasion, as pointed out by Mr. Smith.

It is quite true that the best results are obtained with magnesia when it is used in combination with other fillers, as has been pointed out in the paper referred to above, because this reduces the high permanent set given by magnesia when used alone. It is common practice, of course, in the compounding art, to achieve the desired result in the qualities of a vulcanized compound, by using a combination of compounding ingredients when one alone will not impart the necessary properties of toughness, rigidity or resistance to abrasion.

The typical behavior of the common rubber reinforcing pigments may be outlined as follows: gas black gives the greatest hardness, rigidity and tensile strength and the lowest elongation. China clay gives almost as great rigidity as gas black, but considerably less hardness and tensile strength, and greater extensibility. Zinc oxide gives higher extensibility, but lower tensile strength, hardness and rigidity than either clay or gas black. Colloidal barium sulphate behaves similarly to zinc oxide, except that it does not stiffen the rubber as much. Light magnesium carbonate comes next to gas back in tensile strength, but does not give quite as great hardness or rigidity as clay, although the tensile, elongation and resilient energy are all greater for magnesium carbonate than for clay. Light magnesium carbonate is a filler of low absolute specific gravity (2.18) like gas black and hence gives low gravity compounds, so that its compounding cost per unit of reinforcing effect or per cubic foot of rubber compounded with it, is quite low. On the present basis of prices it compares very favorably with the other most used reinforcing pigments.

There is in progress at the Mellon Institute at the present time an investigation with the purpose of modifying the crystal character of magnesium carbonate in order to reduce the permanent set effect, and at the same time, if possible, to reduce the average particle size still further and increase the uniformity of the material. This should greatly increase the value of the material to the rubber industry.

An improved method of analysis for light magnesium carbonate has been worked out at the Mellon Institute and will be sent gladly to any rubber chemist interested in it. The technical material is found usually to be nearly C.P. and except for hygroscopic moisture the basic magnesium carbonate present is usually in excess of 99 per cent.

You will understand, of course, that this letter is not intended to be in any way controversial, but it is written simply with the purpose of clarifying for your readers some of the facts, regarding this material, set forth in Mr. Smith's rather brief article.

I am, with very best wishes,
Yours very truly,
H. W. GREIDER

What Our English Contemporary Thought of Hugh Chisholm's Speech

Under the heading "A Big Move Forward" the *Rubber Age* of London comments editorially as follows on a passage in the speech of Hugh Chisholm at the annual banquet of the Rubber Association of America last January:

"An eloquent plea was put forward by Mr. Hugh Chisholm, the well-known London editor, at the annual dinner of the Rubber Association of America, for closer co-operation between British rubber planters and American rubber manufacturers. He urged that a great deal more could be done by that association to get both these parties together, and he promised that in any effort that might be made in the way of co-operation in working out their mutual destinies, they would 'find every reciprocity on the other side.' He admitted frankly that it was not for him to indicate any particular direction in which this co-operation could be aimed at and secured. That was for them, around a business table, to secure by private discussion, but he added this interesting prediction: 'I have no doubt whatever, as far as your industry is concerned, that you will see during the coming year a very big move forward, which people in London engaged in the financing of the rubber industry will take in hand and in which they will seek your co-operation in order to make a further start in the rubber industry.' As Mr. Chisholm was formerly financial editor of the *Times*, these words naturally attracted considerable attention and discussion in New York, but we cannot help thinking it was a pity he could not have been a little more explicit, for it is well known in London that some such scheme is under consideration. He either said too much—or not enough."

Covering Wire with Rubber

Copper wire is covered with a layer of rubber by passing the same through the following baths: first through a vessel containing pasty raw rubber, then through a vulcanizing bath containing a 5 per cent gasoline solution of sulphur chloride, then through a heating bath and finally through a bath containing 5 per cent ammonia. (See Japanese Patent No. 37,110).

ABSTRACTS

Technical — General — Commercial

Dental Rubber

In British Patent No. 174,471 there is described a process for making dental rubber. This dental composition, used for making dentures, comprises a mixture of powdered vulcanized rubber sufficiently pure to be used for dental purposes and ordinary unvulcanized dental or similar rubber, preferably in equal proportions with or without the addition of sulphur as required.

Rubber from Rubber Milk

The rubber milk is sprayed into a chamber in a very finely divided state and is dried by means of a current of air or gas at a temperature of 95 deg. C. The pulverized rubber that is obtained in this manner, contains all the non-volatile solid constituents of the rubber milk, such as albumen, etc. The pulverized mass is then pressed into various shapes and forms. Sulphur and other filling materials may be added to the rubber milk before the spraying and drying process. (See French Patent No. 529,327.)

Rubber Solvents

The Deutsche Peerless Gesellschaft m.b.H. of Hamburg has been granted German Patent No. 349,699, which is concerned with a process for the manufacture of rubber solvents. The process consists in treating acidified solutions of clorinated hydrocarbons wood tar and the like with aromatic bases, such as aniline, quinoline, etc. The products obtained in this manner have no corrosive action on the apparatus in which they are used, and the rubber compositions that are made with their aid have been found to vulcanize quicker and more effectively.

Vulcanization of Rubber Articles

The article, for example, a motor car cover built upon an annular core, is placed between the two halves of the outer mold. Without completely closing the latter, steam heat is applied inside the vulcanizing chamber until the tread rubber is sufficiently softened, the steam pressure being then reduced so that any condensed water in the mold is re-evaporated. The mold is then closed by mechanical pressure and vulcanization is completed by re-admitting steam into the chamber. This procedure reduces the displacement of the fabric by the flow of the rubber in the mold. (See British Patent No. 175,383.)

Rubber Compositions

British Patent No. 176,404 is concerned with the preparation of rubber compositions which are intended to be formed into sheets for the manufacture of boot soles and heels, disks for universal joints, etc. The process consists in mixing together unwoven organic or inorganic fibers, or both, which have been treated previously with a cementitious material with a phenol condensation product and rubber. The finished material may be made solid of the required thickness with or without reinforcements or it may be built up of two or more layers with or without intervening layers of wire, cord or other similar reinforcement. Waste fabric which has been bonded with a cementitious substance may be disintegrated, or raw fibers may be specially treated with the enamel or the like. A suitable composition for this purpose is rubber 26 parts, disintegrated previously treated fibers 6 parts, sulphur 6 parts, carbon black 1 part and lime half a part. The mixture is vulcanized for one and one half hours at a steam pressure of 45 pounds per square inch.

Waterproofing Cloth

A mixture, containing gasoline, asphaltum, paraffine and rubber, is used to waterproof mohair cloth, which is the material used particularly in making automobile tops. The first step, in this process is to dissolve the asphaltum in the gasoline. About 20 pounds of the latter substance are dissolved in 5 gallons of gasoline. The paraffine and the gasoline are then mixed together separately, the proportions being about 5 gallons of gasoline to 3.25 pounds of paraffine.

The two solutions are then thoroughly mixed together, after which about one pint of vulcanizing rubber dissolved in one gallon gasoline is added. A fine grade of Para rubber is used for this purpose. The mixture is now ready to be applied to the cloth, and will impart to it waterproofing qualities, besides coloring it a deep black and giving it a high gloss. Two coats are sufficient. Other pigments may be used to give the waterproofing composition the desired color. For details see U. S. Patent No. 1,391,934.

Vulcanization Process

Rubber is vulcanized by the admixture of a substance which when heated with rubber at the temperature at which vulcanization takes place will liberate sulphur in a nascent or active state. Rapid vulcanization is produced in this manner. The substance may be used as the sole vulcanizing agent in the rubber mix, but it is more preferable to mix some sulphur in as well, so that the aforementioned substance will act as a sort of accelerating agent. The substance in question is a thiosulphate, and of the various thiosulphates that may be used, such as strontium, calcium magnesium, etc. the one preferred is barium thiosulphate.

This salt is a stable powder and is obtained by precipitating sodium or other soluble thiosulphates with barium chloride. The decomposition of the thiosulphate at the vulcanizing temperature produces sulphur, barium sulphide, barium sulphite and barium sulphate. Each molecule of the thiosulphate will liberate one atom of suphur. The residue of the barium salts is inert, non-volatile and white in color, and is not in any way objectionable in the finished rubber articles, but is rather desirable as a filling material. This is claimed to be a decided advantage over certain organic compounds that are now used as accelerators, which are decomposed to give compounds which are poisonous and have an injurious action on the vulcanized rubber. This process is patented in United States Patent No. 1,406,197.

Rubber Repairing Solution

A new rubber composition, which is suitable for use in repairing rubber articles, is described in United States Patent No. 1,398,979. The new composition is a compound made of rubber, a rubber solvent and a small percentage of a ketone, preferably acetone while the solvent is preferably carbon disulphide. The rubber is used in the unvulcanized condition and is preferably Para rubber. The process of making the compound is very simple. The non-vulcanized rubber is first cut up into small pieces and then dissolved in the solvent. The mass is agitated vigorously in order to hasten the dissolution. Then after the rubber has been dissolved entirely, a small amount of ketone is added and the mixture is packed in air tight cans. The best results are obtained when one pound of rubber is used to a gallon of carbon disulphide to which about 2 per cent by weight of acetone is added. The product is semi-liquid and when exposed to air it quickly starts to congeal and then gradually solidifies. The acetone evaporates quickly with resulting lowering in the temperature, and when the mass is solid it forms a rubber-like product which is as flexible and soft as vulcanized rubber and is capable of being stretched without showing the least tendency to wear. The mixture adheres to rubber very firmly and can be used to good advantage in making patches. The great advantage gained with its use is that the rubber compounds solidifies within fifteen to twenty minutes after application, while vulcanization would take considerable longer time.

Recent Developments in the Chemistry of Rubber

By William C. Geer

Vice President in Charge of Development
The B. F. Goodrich Company

RUBBER as it appears to the consumer in the form of tires, hose, or rubber overshoes is not a chemical individual derived by the operation of chemical processes nor is it the crude rubber of nature. The rubber articles are made up from one or more of thousands of mixtures, each composed of several different substances. These substances are made into mixtures by mechanical means, and to give them the physical properties required each must be submitted to the one chemical process of the industry, the action of temperature and time known as vulcanization. To attain highest values, the chemistry of these raw materials, of the vulcanization operation, and of the finished mixtures has been diligently studied during the past few years. From this study have come some interesting developments.

Early Development

While rubber was made known in its raw or crude form to the Europeans by Columbus, and other explorers in the sixteenth century, it remained until the third decade of the nineteenth century for a phase of its chemistry to be recognized in a practical way, and only within the past few years have chemists come to reasonable conclusions with respect to the mechanism even of this fundamental reaction. You may pardon me, therefore, if I refresh your memory with some of the older and to rubber men well-known ideas, in order to pave the way for a brief discussion of the new.

WILLIAM C. GEER

The raw rubber is a vegetable product derived from the milk or latex which flows after cutting the bark of certain trees which grow profusely in a belt about two hundred and fifty miles each side of the equator in countries where the soil, rainfall, and climate are propitious. Spaniards in the sixteenth century saw South American natives spread this latex upon crude fabric. The crude rubber layer thus formed served as an excellent water-proofing medium. The first rubber shoes were made by the Indians, who poured latex over clay lasts and dried it in the smoke of a fire. Men, like cats, abhor wet feet, and shoes are really our earliest useful application of rubber.

The dried product, as a brown, frequently evil-smelling body, came into Europe in the eighteenth century. From then on, chemists and practical men studied this product in the attempt not only to determine its composition but also to find ways and means of utilizing it. Priestley named it, Faraday analyzed it, Hancock found uses for it, but there were fundamental difficulties which restricted its use and caused many thousands of articles to be returned to the manufacturers. The rubber was found to "dissolve," as it was termed, in turpentine and coal-tar naphtha. This solution or cement was spread upon cloth to make raincoats. It had, however, the disadvantage of being sticky and of softening with heat and stiffening with cold. Even the milder climate of England, but especially the heat of our American summers, caused the coats to fall apart and to stiffen so decidedly when worn in the winter that they became virtually like tin armor. An early story has been told of a man who wore one of these coats in the winter in New York, who, finding the garment so stiff that it was difficult for him to get around with it on, came in and sat down in front of a hot fire in order to soften it. It did soften and too much so, for it became necessary for friends literally to cut the garment from him. Investigators with scientific as well as only inventive training made efforts to dry and stiffen the product, and this led to the development of mixing machinery. The rubber mixture was thus developed.

One early practical man, Hayward, conceived the idea of dusting sulphur upon the surface of rubberized cloth and submitting it to the action of sunlight; he found a drying action on the surface but no change in the effect of heat and cold. One day a hardware merchant who had failed in business but who was of an inventive turn of mind, Charles Goodyear, was attracted to the window display of a rubber company in New York, where he saw life preservers made of rubberized fabric. One thing led to another, and he was stimulated, as he says in his memoirs, to study means for eliminating the undesirable effects of temperature. He learned of the Hayward patent, purchased it, and began experiments with the mixing of sulphur into this crude rubber. Finally, to tell his own story, he observed one day in January 1839 that certain mail bags which had been returned by the Government, the rubber part of which consisted of a mixture of rubber, sulphur, and white lead, had not softened after standing for some time in the vicinity of a hot stove. Without scientific training, but with the instincts of an investigator, he at once was led to further experiment as a result of this observation. He made numerous trials until he came clearly to the conclusion that time and temperature with a rubber-sulphur mixture were the two controllable factors which would cause a change in rubber by which it would remain flexible in the cold and not melt when heated. This process was later named vulcanization. Vulcanization, however, changed not alone the hardness under changing temperature conditions but altered a number of physical properties. The breaking or tensile strength, which is a most important property for industrial and service uses, was increased.

I have mentioned this incident in the history of rubber, purely to give credit to those early scientific minds, for we all know how many of the greatest discoveries in the laboratories of the scientists, in the practical work of the factories or even in the crude workshop of an untrained inventor, are due to keenness of observation. If young men under training or who are at work in our factory laboratories could only learn that at least one fundamental for success is the faculty of keen observation to see leads into new territory, how much faster would our research work proceed! Goodyear not only discovered the fast of an interaction between rubber and sulphur, but he also discovered and described in his patent the first accelerator of vulcanization, the Dutch process white lead.

The growth of the rubber industry from its meager output of $7,000,000 worth of products in 1850 to $1,122,000,000 worth in 1919, all of this being based upon this fundamental principle, is one of our striking industrial achievements. These facts of early history show how close should be the connection between mechanical invention and chemical research. Chemists are quite justified in using the term "research" for their part of such coordinate enterprise. The inventions of the early workers failed to develop the rubber industry. I think we must call Goodyear a chemist, although he was not trained as such; but sometimes men become chemists or physicists, or even financiers, without training.

Crude Rubber

Let us go back now and trace step by step rubber as it grows

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in the tree down to its use in practical products and discuss some of the recent developments which give us a deeper insight into the chemistry of these various processes. Through the researches of De Vries and others our knowledge of the chemistry of the latex and of raw rubber has come to scientific exactness. Rubber latex is a colloidal suspension. It exhibits the Brownian movement, and under the miscroscope the size of the particle is approximately 0.0005 to 0.003 millimeter. These globules are not always spherical. Since it has characteristics of a solid it is reasonable to suppose that crude rubber is produced in the tree in glands or cells which put it into the watery fluid or serum of the latex in solid form.

An average analysis of the latex shows it to contain the rubber hydrocarbon as its chief constituent to the extent of 28 per cent, 1 to 3 per cent of resins, mineral matter, sugars of several kinds about which little is known, proteins, if we may call the nitrogenous matter by this general name; the balance, about 60 per cent, is water. Commercial rubber includes several of these substances and so exists to about 30 to 35 per cent in the latex. It is highly probable, in view of the action of different grades of commercial rubber, that the resins are in solution in the rubber hydrocarbon; it is pretty definitely known that the protein plays the part of a protective colloid. There is an interesting field for colloid study here, for the protective action of these proteins in the latex is different in different species of trees. That from the Hevea tree does not cream on standing nor can these fine particles be separated by any centrifuging process that has yet been applied to it. On the other hand, the latex from other trees, notably the Castilloa, will cream with relative ease, and rubber may be separated by mechanical means. We may possibly compare the percentages which have been given with that of milk in which the butter fat runs only from 3 to 6 per cent, and the proteins from 3 to 4 per cent, and which readily creams on standing.

Rubber latex, the moment it comes from the tree, begins to change; the action of bacteria is rapid, probably first affecting the proteins, changing them to amino acids, amines, and various other decomposition products. It is highly important in the practical handling of latex to carry it to its first manufacturing step before these bacteria can make too great an alteration in this liquid; otherwise crude rubber of different colors and physical properties would result with consequent lessening of its value in the markets.

Coagulation—The first step in the manufacture of crude rubber consists in coagulation, around the study of which there has been a great deal of scientific work. Investigators have found, as those who understand colloid chemistry would expect, that dilution of the latex to a standard rubber concentration is the first fundamental, and the second one is the breaking down of the protective action of colloids by means of acid of the right concentration. Various acids have been tried: formic, sulphuric, hydrochloric, and others. Various electrolytes have been used, but up to the present time a concentration of about 1 per cent (in terms of rubber) of acetic acid gives the best product.

Coagulation is known to be a simple massing together of the rubber globules. The rubber itself is not changed, and as a result of this addition there is formed at first a soft, white dough which, when congealed enough to be capable of practical handling, is washed free from serum, acid, and other substances upon a washing mill. About 95 per cent of the rubber now prepared on the estates is made by the acetic acid method, which gives a crude material of good appearance. When made in this way and where discoloration is prevented by small quantities of sodium bisulfite, there results the "pale crepe" of commerce. When, however, the sodium bisulfite is not used, and in addition an attempt is made to imitate the smoky odor and appearance of the original Brazilian grade by a smoke-house process applied after the rubber has been washed and partially dried, there result the "smoked sheets" of commerce.

There are many unsolved problems of a mechanical as well as of a chemical character. A most excellent grade of crude rubber has come into the market in recent years which is prepared by the total evaporation of the latex. This has good properties, although not greatly different from that prepared by the method already briefly described. The real field here probably lies in a study of the action of polymerizing chemicals, for there is no better place to submit a substance to chemical action than when it is in its most finely divided state. Some day enterprising chemists, either of the rubber factories or in connection with the government experiment stations or private estates, will study substances to be added to the latex to serve as polymerization agents prior to coagulation to give us grades still better than we now receive

Cultivation—The cultivation of rubber trees on plantations or estates is the result of an idea of the Englishman, Hancock, who suggested it in 1856. It was carried to completion by another Englishman, Sir Henry Wickham, who in 1876, with the support of the officials of the Kew Botanical Gardens, succeeded in shipping out of South America some seeds of the best tree, the black *Hevea brasiliensis*. The seeds were planted in the Kew Botanical Gardens. The young sprouts were sent to Ceylon; seeds from these trees were sent in later years to Sumatra and the Malay Peninsula. From then on, the rubber plantation industry has grown, and it only remained for the tremendous demand incident to the use of crude rubber to support the automobiles of the world, until an industry which produced but four tons in 1900 developed a production of 304,000 tons in 1920. Over seventy-five per cent of the total world's product comes to America. To supply the world with 300,000 tons of crude rubber requires about 270,000,000 gallons of rubber milk. Of these tons which come into America, about 75 per cent are used in pneumatic tires, solid tires, and inner tubes. Probably one-third to one-half of the world's production comes to the city of Akron, Ohio.

There were under cultivation only 116,000 acres in 1905 and over 3,000,000 acres in 1920; over 70 per cent of this acreage is owned by British capital and about 66 per cent of it is under the political control of Great Britain in her Colonies. As a result of the tremendous demand in 1910 and the over-supply in 1920, the price of this material fell from $3.00 a pound to about 13 cents a pound. When one considers that the cost of production of plantation rubber varies from 18 to 25 cents per pound, it is obvious that additional ideas for its use in new articles will be most welcome. In the economics of rubber illustrated by these figures, London is to-day the financial center, the city of Singapore on the Malay Peninsula the shipping center, and Akron the manufacturing center.

Composition—This plastic raw rubber is shown by the best analyses to consist of the rubber hydrocarbon 92 to 94 per cent, 1 to 4 per cent of moisture, mineral matter, resins, and proteins; in other words it is not far from the composition of the latex, with the exception of water and water-soluble ingredients. Ultimate analysis shows the composition of the rubber hydrocarbon to be $(C_5H_8)_x$. On account of the supposed relation of rubber to the true terpenes, we customarily think of it in terms of the formula $(C_{10}H_{16})_{x/2}$. The structure of the hydrocarbon has been subjected to much controversy. Chemists now generally agree. Isoprene, C_5H_8, is a methyl derivative of butadiene. This butadiene hydrocarbon consists of a chain of four carbon atoms with alternate double bonds, or a conjugated system of double bonds. Addition to such a system takes place at the ends and causes the formation of a double bond in the center. We believe that the polymerization of isoprene to rubber consists in the addition of one molecule to another in this way, forming a succession of these groups linked together into a ring of uncertain dimensions. How far the chemical composition or state of polymerization, or the state of aggregation of the polymerized magmas affect the properties of crude rubber as we know them, and how far the hydrocarbon from trees of various ages differs chemically and physically are all unknown phases of this interesting problem. We do not know the part played by mineral substances nor the exact condition of the nitrogenous matter, although the proteins have a most important influence upon the colloid characteristics of the rubber.

Much study has been made by some chemists in the analysis of rubber to determine the percentage of acetone-soluble matter. Rubber from different botanical species varies largely in resins. Vulcanized rubber changes on standing, owing to the formation of acetone-soluble oxidization products. The rubber resins are highly complex and whether they were the original source of rubber in the tree or whether they have been produced from the rubber we do not know. The acetone extract is probably to-day the one reasonably reliable means

of determining the botanical origin of different grades, and the fresh from the deteriorated rubber, although the control of quality in a finished article can be carried on irrespective of the origin of the rubber, and the amount of acetone extract is not, as some have believed, a guide to quality of a vulcanized rubber mixture.

The chief chemical property of the rubber hydrocarbon is unsaturation. It adds directly halogens, halogen acids, sulphur, and sulphur chloride, as well as certain other substances.

The story of synthetic rubber has been much discussed. Synthesis of it is a well-known fact. Much work was done upon it during the war in Germany, where considerable quantities were produced, but it was not the same hydrocarbon as that derived from the tree. It was a close relative known as methyl rubber. However, the tires and other soft rubber articles made from it were decidedly inferior in service. It was, however, valuable in hard rubber or ebonite.

Colloid Chemistry

The study of the colloid characteristic of raw rubber constitute an important field in which our knowledge is growing. Consider that the latex contains innumerable very small solid particles surrounded by a protective colloid. On massing the rubber together there is reason to believe that a definite structure remains. The rubber is probably still surrounded by the film of protective protein colloid, or in any event the interfacial tension between these particles when massed remains great enough to have an appreciable effect upon the properties of the substance. When rubber is softened, or as we call it masticated, upon a mixing mill, even with the minimum of heat, a change occurs, in which probably the protective colloid is broken up and mixed with the rubber, without, however, radically altering its vulcanization properties. A cement of softened or masticated rubber in bezene is thinner than one made of unworked crude rubber. This phenomenon could lead one to believe that this crude rubber may contain a structure which can be broken down by mechanical action but not by the method of absorption in a solvent. When a sufficient amount of it is placed in a solvent it swells, showing absorption of the solvent by the rubber, and only after a long period of time will it become a viscous solution or cement. Indeed to gain uniformity it is necessary to beat it up. Yet in this form it is not a gel and does not show the phenomenon of syneresis. These data seem to indicate that a benzene rubber cement is therefore simply an emulsion of benzene dissolved in rubber as one component, dispersed in benzene as the other component.

Some interesting studies by Stevens in England on vulcanization in solutions are presenting some leads into the colloid chemistry which if followed may give us information of marked value. It has long been known that when vulcanized rubber is placed in solvents it does not dissolve but merely swells, the swelling action being one and one-half times in ethyl ether, nearly double in benzene, and about two and one-half times in chloroform. Swollen vulcanized rubber is weak but may on standing lose the liquid by evaporation and return to its original size. Stevens, however, has vulcanized a rubber sol to a gel, which on evaporation of the dispersion medium he states yields a soft vulcanized rubber of normal properties. This he has done by the cold or sulphur chloride vulcanization method, working with benzene solutions of masticated plantation rubber. He has formed gels almost immediately. Syneresis sets in and the gel contracts, expelling the solvent which contains little or no dissolved rubber. He has also obtained vulcanized rubber sols by heating raw rubber sols in a sealed vessel under pressure. These on spontaneous evaporation yield films of vulcanized rubber which cannot be redissolved in rubber solvents. There is much of interest to be determined from a pursuit of this field.

Absorption of Light

The absorption of light by crude rubber has recently been investigated by Lewis and Porritt, who find no decisive evidence of absorption bands, but a general absorption which is fairly strong for wave lengths below 2700 but rapidly diminishes with increase in wave length. It may be that this investigation will give us further evidence and an explanation of why the rubber is so rapidly oxidized in the presence of ultraviolet light.

Diffusion of Gases

The early studies of crude rubber with respect to diffusion of gases through it have recently been worked out on a scientific basis for both crude and vulcanized rubber by Venable and Fuwa, who examined two grades of crude rubber and two vulcanized compositions. This work was stimulated by the use of rubberized balloon fabric during the war, and these investigators made a most interesting and valuable contribution in relation to balloon work. The amount of gas thus held in the rubber was directly proportional to the pressure, and unaffected by the degree of vulcanization or the presence of compounding ingredients. They verified the customary assumption that the mechanism by which a gas penetrates a rubber membrane is through diffusion of the gas, which is held in true solution. This it is to be hoped, will lead to a further investigation so far as hydrogen and helium penetration is concerned, to find components which will reduce the solubility of these gases in rubber mixtures. Could we use in dirigible balloons a rubber mixture highly insoluble toward hydrogen and helium a great advance could be made.

Another problem in this field is the development of a rubber mixture in which war poison gases are insoluble. Our Washington friends may agree to abolish poison gases from warfare. We should, however, be active in preparation of methods of defense against it. We are forbidden to carry concealed weapons, but there is no law of God or man to prevent us from the use of locks on our doors and bolts on our windows.

I would earnestly recommend to the American Chemical Society the extension of gas defense research to investigate gas mask and other protective clothing, alone as far-sighted patriotic citizens if cooperation with the War Department be not allowed. It is a field in which research work of a cooperative character can be undertaken, with who knows what valuable results to us in the future.

Vulcanization

The chemistry of vulcanization is probably that phase of rubber chemistry which has attracted the most attention during recent years. One of the earliest of the various processes of vulcanization, other than the previously mentioned hot vulcanization with sulphur, is the so-called "cold" process, discovered by Alexander Parkes in 1846. He vulcanized sheeted crude rubber by dipping it for a few minutes in a 1 per cent solution of sulphur monochloride, S_2Cl_2. This is conceived to be a direct chemical addition up to a limiting composition of $C_{10}H_{16}.S_2Cl_2$. This result, however, yields a solid, usually obtained as a powder. When quantities under 3 per cent are added we obtain soft, vulcanized rubber, as known in form of toy balloons, nipples, and surgeons' gloves.

The Peachey Process—A most interesting cold process has recently been developed by the Englishman, Peachey, who first proposed his new plan in 1918. This new process consists in exposing rubber alone, or a mixture containing any useful pigment, to two gases alternately, namely, sulphur dioxide and hydrogen sulfide. The first diffuses into the rubber until the proper quantity has been taken up and then the second gas is permitted to diffuse in it. They interact with the liberation of nascent sulphur, bringing about a rapid vulcanization without the aid of heat. The claims made for the process consist essentially in the advantage given to rubber compositions which would otherwise be injured if the usual hot vulcanization method is employed. Mixtures containing leather, cotton fiber, and colors which would be altered by heat, particularly with respect to rubber surface clothing, may now be vulcanized at ordinary temperatures without injury. The process has not yet been conducted on a large production scale.

Nitro Compounds—Somewhat earlier, in 1915, the Russian, Ostromuislenskii, discovered that a hardening similar to vulcanization occurred when rubber is heated without sulphur in the presence of certain nitro compounds or peroxides, such as trinitrobenzene or benzoyl peroxide. Whether this is a gelation phenomenon, an adsorption, or an additive chemical reaction has as yet not been proved.

Hot Vulcanization—We now come to a discussion of what has been learned regarding the hot vulcanization of rubber with

sulphur, which is the only process in large commercial use. The idea prevalent fifteen years ago when I first entered the rubber industry, and one which still prevails in the minds of many practical men, is that sulphur vulcanization does not occur until the temperature of the mixture has reached or exceeded the melting point of sulphur. Vulcanization to-day, however, is known to occur at ordinary temperatures if the time be long enough—sixty to ninety days in the case of old-fashioned mixtures. When certain recently discovered powerful catalysts are employed in the mixture, the hardening may take place on standing over night. Whether the temperature be low or high, we know that the amount of sulphur that enters into combination with rubber increases with time and rise of temperature; that is, the velocity of the reaction is proportional to the time at constant temperature and if the temperature and the time be fixed, the amount of sulphur entering into the molecule is dependent upon the quantity originally present.

When small amounts of, say, 3 per cent of sulphur are thus "combined," as we say, there results the soft rubber of commerce. In almost all instances there is a slight excess of sulphur left in solution in the rubber as "free" sulphur. This usually gradually diffuses to the surface, where it crystallizes out and appears as a powder or "bloom". This amount of combined sulphur, expressed as a percentage figure in terms of rubber as 100 per cent, is known as the "coefficient of vulcanization". No chemical individual of the rubber hydrocarbon and sulphur has been isolated from soft, vulcanized rubber mixtures. Yet their properties vary from the under-vulcanized, or "under-cured", mixtures in which the amount of combined sulphur is low, to the over-vulcanized, or "over-cured," mixtures in which the amount is high.

There are wide and, to the manufacturer and consumer, vitally important differences in physical properties between under-, proper, and over-cured rubber articles. Yet we have as yet only theories of a general character to explain the nature of the product of vulcanization.

When a large excess of sulphur is used in a mixture, addition goes on up to a maximum of 32 per cent of combined sulphur, and there results the only compound which has been isolated—a monosulphide C_5H_8S, or, as usually written, $C_{10}H_{16}S_2$. It is in the laboratory a brown, dry powder. In the factory and in commerce we know it as hard rubber or ebonite, in battery jars, sheets, fountain pens, and so on.

Ostwald's theory of physical change led to the many discussions that have arisen between the two camps of chemists: those who expound the sulphur adsorption theory of Ostwald and those who stand by a chemical theory. The great father of rubber chemistry, Weber, was an exponent of the chemical theory. We to-day, I believe, adhere to a combination of a chemical and physical theory as most reasonable for the explanation of vulcanization. The fact that no compounds have yet been isolated in the soft rubber range of vulcanization is no reason for us to believe that a purely physical theory alone will account for it.

We have not yet found a process by which the combined sulphur can be removed and the original rubber regenerated. The rubber industry is, however, economical, and uses up its waste products. The old tires, shoes, and hose are gathered and reclaimed by processes which simply hydrolyze and separate the cotton while the vulcanized rubber is softened to permit it to be plastic enough for remixing. Let me here state in justice to my brethren in the industry, all statements to the contrary notwithstanding, that reclaimed rubber is a valuable ingredient in many rubber mixtures. Over 70,000,000 pounds are used annually in this country, or about one-quarter of the amount of crude rubber employed; an economic consumption of no mean magnitude, of what otherwise would be waste.

Accelerators

While the nature of the product obtained when sulphur and rubber interacts is indefinite, the rubber chemists in recent years have reached some pretty clear conceptions of the mechanism of the process, particularly the part played by catalysts. From the day when Goodyear used white lead, various types of inorganic compounds have been employed as accelerators. They have been chiefly lead compounds and oxides of the alkaline earths, with, in laboratory experimentation, for instance, the hydroxides of the alkali metals and the sulfides, and hydrosulfides of the alkalies and alkaline earths.

The use of organic compounds for speeding the time of vulcanization is probably one of the most important developments in the chemistry of rubber and of greatest value in practical affairs. They have served not only to increase the rapidity of turn-over in the factories, but have led to increased physical properties of rubber mixtures. The name of the first person to use organic accelerators in rubber factory practice has never been published. The writer feels it to be in the interests of truth to give here public credit to the two pioneers of the organic accelerator. The laboratory record books of The Diamond Rubber Company, which was later consolidated with The B. F. Goodrich Company, show that Mr. George Oenslager, in the early months of 1906, experimented with aniline oil, and a long list of other organic compounds, with the definite purpose of hastening the time of vulcanization. In June of that year, Mr. A. H. Marks directed its use in factory formulas, and in February 1907 he used thiocarbanilide. The German patents were not published in this country until 1912, so that it may be safely stated, unless some one comes forward with earlier unpublished data, that the use of the organic catalysts of vulcanization originated with Mr. Oenslager and Mr. Marks in 1906.

Basic compounds were first used, particularly nitrogen derivatives. The literature mentions large numbers of them; piperidine, aldehyde ammonia, hexamethylenetetramine, the aliphatic amines, and so on, have been used in practice. The dithiocarbamates came into published literature with Ostromuislenskii in 1915. Bruni, Maximoff, and others have studied the thiuram disulfides, and within the last few years the xanthates, particularly the zinc salts, have been discussed. In rubber mixtures, for laboratory purposes, accelerators have been found which permit the vulcanization of rubber and sulphur at all ordinary temperatures. Mixtures can now be made which will vulcanize over night on standing at room temperatures and at very short time from then on up to usual factory practice, which are temperatures under 150° C. By proper selection of accelerators, even cements may be vulcanized to gels on standing for several hours at room temperatures.

How these substances act and why, have been pretty well established. Zinc oxide in a mixture has long been known to promote the action of the accelerators. Kratz, Flower and Shapiro stated that zinc salts are formed in many instances, and that these are the active accelerators. They show how the thioureas can form zinc salts through tautomeric change. These are similar to the zinc dithiocarbamates. Bruni and Romani assume that the thiourea is converted into a zinc salt, as just mentioned, and that sulphur acting with this zinc salt forms a thiuram disulfide which acts as a vulcanizing agent. Twiss studied alloptropic forms of sulphur but was able to show no difference in the action of the two.

In my opinion, however, the best work on the theory of acceleration has been that of Bedford and his associates, Sebrell and Scott. They show hydrogen sulfide to be an important factor in the mechanism of vulcanization and, generally speaking, that all vulcanizing reactions may be ascribed to some form of polysulfide sulphur. The original accelerator then, whether metallic, organo-metallic, or organic, forms with sulphur polysulfides which yield sulphur in a more active state than when in its elementary form.

These substances cannot be termed catalysts in the true sense, at least so far as our idea of contact catalysis is concerned. They do serve to permit sulphur to be more actively taken up by rubber, but in doing this they are often changed themselves and then are left permanently changed in the mixture. Intermediate compounds are formed. The reaction is more chemical than physical. There is no poisoning of the accelerator except the retarding action of acids. Nor is it a case where a given quantity may react with a relatively large amount of the reacting substances. The quantity of accelerator has a very definite relation to the time and degree of vulcanization. Furthermore, essentially all accelerators, according to the best of our evidence, such for instance as that of Whitby and Walker, show not only an increased speed of reaction but also an increase in the tensile properties of the rubber. We gain, therefore, two points: one, the velocity of

reaction, and the other, improved physical properties. We had better call them accelerators and let it go at that.

The physical properties of rubber mixtures have been studied, and chemists are more and more coming to use the stress-strain relations as guides to the evaluation of mixtures. Wiegand, in a most interesting study, showed that the addition of different volumes of different dry inorganic powders which we call pigments increased the energy-absorbing capacity remarkably in the case of gas-black, lampblack, and zinc oxide; increased it to a slight degree in the case of a fine clay, but decreased it in the case of whiting, fossil flour, barytes, and glue. He also called attention to what the older rubber men have long known, that the tensile strength of a rubber mixture usually computed against the cross section when at rest and before testing may, if computed against the section at the break, exceed twenty tons per square inch, which would bring rubber into the class of mild steel. It is the only substance for which the elastic limit extends to the point of rupture. The number of foot-pounds of energy that can be stored in a unit weight of the material exceeds steel many times. It is an interesting physical study which tells us that such stored energy in tempered spring steel is only 95.3 foot-pounds, while in a high-grade rubber it is over 15,000 foot-pounds.

To explain the properties given to rubber mixtures by these dry powders, determinations have been made of the particle size, by Green and others, who have photographed under the microscope these various materials. From these and other data we come to one important conclusion, namely, that the particles of large size are not as strength-giving in rubber mixings as those of small, while particles which seem to separate from the rubber when stretched are the ones which are of less value in mixings which must resist abrasion.

The use of carbon black and zinc oxide is really based primarily not only on their fineness of subdivision, but on some factor which we have yet to determine but which may be due to an increase in the interfacial tension. That is, they are so fine in subdivision and so specific in their adhesion to rubber that they not only approximate what we may term "mass molecules" but have a degree of specific adhesion to the rubber, making it thereby difficult to break them loose when rubber is submitted to stress. There has been an amusing controversy between the exponents of the sale of carbon black and zinc oxide over which one is the best. I will leave it with you; they are the two best materials—one is the king and the other the queen of pigments. You may use them singly or together and take your choice as to which will have the preference in the processions of your royal family. Some unpublished data go to show, however, that both are essential to the highest values in some rubber mixtures.

You must not now let me leave you with the idea that these few substances constitute the whole of rubber mixtures. I wish they did, for then my early dream would approach realization. When I first came into the rubber industry fresh from a university I thought how easy it would be for me in a relatively short time to solve this compounding problem. I had been trained in the phase rule, with a reasonable amount of mass law and electrolytic dissociation thrown in for good measure, so I hoped, of course, to find rubber a simple three-component system capable of explanation on a triangular diagram. But as soon as I became acquainted with the properties in compounding of from 400 to 1500 dry pigments and with organic accelerators which in the years that have followed have run upwards of a thousand; with reclaimed rubber of a hundred grades; with crude rubber in twenty to a hundred different kinds, and all these to be used in mixtures with cotton fabric of thousands of weaves to make ten or twelve thousand different articles in different sizes, shapes, and for different purposes, I came to have a very high respect for the practical man. After all, rubber, as a consumer gets it, is not a simple mixture of rubber, sulphur, and accelerator; in the interests of numerous physical properties required for service in the form of shoes, frictions, treads, and belt covers, other materials must be used. We have found in recent years how these materials serve practical purposes and are not simply to be considered as cheapening fillers. In point of fact, to-day many pigments cost more than crude rubber. The colloid particle, the fumed products, and the ground inerts all have definite uses in giving us serviceable as well as economical rubber products. The rule-of-thumb methods are gone from the leading laboratories, but the variables are so extended that the service test has become the final judge of the value of any mixture.

May I be pardoned if I speak from the vantage of research and experience to those who would write specifications for rubber articles? For years plantation grown crude rubber was ruled out—organic accelerators and carbon black excluded. Yet the industry advanced, used these substances, and improved the quality of its products. Where specifications seem essential, may I recommend only tests, and those which have a definite relation to the service the article is to render?

While we have developed research laboratories to show us why, development departments to show us how, testing machinery to give us results, we, nevertheless, are constantly faced with the question: Will it age? Rubber is a perishable product. For any purpose a knowledge of the rate of deterioration is most advantageous. This is a serious problem and a vital one to manufacturer and consumer. Heat, light, oxygen, and sulphur play their parts in the drama but as yet no definite theory to account for the varied rate of aging has been proposed. In the vast majority of cases too rapid decay is due to over-cure of the mixture. To determine over-cure and how rapidly a new compound will age in comparison with one of known properties, I devised a test some ten years ago by which the rate of decay could be predicted. I have recently published some results from this ten years' experience from which I now believe that in the heat of 70° C. with plenty of air, one day in the "short life oven" corresponds to about six months of natural aging.

As not only a chemist but a practical rubber man, I could not let go this opportunity of saying something of the future of rubber. The automobile has made the rubber industry, just as the rubber industry has made the automobile. You could not enjoy your cars if you had to follow the practice of Germany during the war, with steel springs and wooden blocks and other devices which were used in the attempt to get along without the softness and springiness of the rubber tire. Improved highways, whether for train or motor car, are essential to human prosperity and growth. It is rubber in the form of tires, air brake hose, insulation, packing, and manifold others which has made these highways capable of efficient and comfortable use.

With about twelve million automobiles in the world and about ten million of them in the United States, one must look forward and let his mind revert from days of depression to the future of larger use of these articles. There are about twenty-four million homes in this country; there is scarcely a new house built nowadays without its garage. When one looks at the map of the world and considers the millions of people who will need improved highways for transportation purposes throughout the great continents of Asia and Africa, let alone an increasing desire for these facilities in Europe and America, we can expect a vast increase in motor car transportation and with it of rubber tires.

Rubber articles have woven their way into myriads of uses. We have found, for example, that soles and heels of rubber give comfort and yield long resistance to wear, for rubber mixtures outwear leather wherever they have been placed in comparison with it. The home, the shop, the school, the office, directly or indirectly, derive benefits from them. It is one of those substances which unfolds possibilities for new applications which stagger the imagination. The chemist has and will continue to play a most vital part in these developments. The automobile tire of ten years ago gave a satisfactory mileage of four thousand miles, while to-day the cord tire would scarcely be considered of value on your cars if it did not give you ten or more thousand miles. Essentially all rubber articles have been improved in service, achievements due in no small part to the developments in the chemistry of rubber of which I have spoken.

With this picture in mind, one can see only larger values, provided, I believe, that the chemists of this industry are supported by the financiers in the conduct of research work. Many problems are still unsolved; civilization changes; only as an industry bases its progress year by year upon the results of research, will it attain permanence in its growth.

The Use of Ebonite Dust in Hard Rubber Goods

THE manufacture of ebonite requires much experience and considerable technical knowledge, and to produce high-class articles with the inclusion of dust as the principal ingredient much depends upon the quality and its preparation, together with the degree of fineness of this prepared substance.

Making hard rubber goods with large percentages of hard rubber dust in the compounds is comparatively a new process, and one which has become very important in the ebonite industry. Ebonite scrap such as wood, tube, sheet, mouldings of all descriptions, which were formerly relegated to the scrap heap and considered of no value, are now a valuable source from which the dust used in the manufacture of a great variety of ebonite goods is made.

By this means an excellent outlet is found for the scrap material, and if the supply is not equal to the demand the ebonite scrap or dust is either purchased from outside sources or preferably manufactured on the premises from start to finish. To buy either in the dust form or as scrap ebonite may be quite a sound policy, but where high-class work is essential, and to prevent as many difficulities as possible creeping in, it is a much more reliable proposition to manufacture one's own, as the various ingredients, etc., methods, and operations are under control, which is a great asset, and when dealing with an ingredient made under these conditions assists in producing uniform products, whereas if purchased troubles may arise, and it is difficult to trace the origin.

In dealing with the scrap which one has for disposal, this should be sorted and divided into three grades, viz., low medium and high. The grading should be put into the hands of very experienced hands, as the inclusion of wrong material is certainly going to show itself in the manufactured article. The material is then slightly warmed up to make it easier for working, and then put once through cold rolls slightly open; the rolls are then tightened fast up and the material put through again, cold water running through during the whole operation. Care must be exercised, and the dust must be continually agitated, otherwise it will take fire and carbonise, so becoming useless for compounding purposes. The dust is then sifted to the required fineness, and stocked in strong tins, with a tight-fitting lid to prevent the inclusion of dust, grit, or other foreign matter. The tailings are again put through the same process until all disappear in sifting.

To manufacture ebonite for the purposes of making dust, cleanliness must be strictly observed. The rubber should be specially selected, free from grit, etc., and if necessary washing and drying should be resorted to. All machines and receptacles should be thoroughly cleaned down, and lining trays and the actual pan and press should be perfectly clean. Another important point is that of curing. If not cured under suitable conditions, many difficulities arise in the finished article, the chief trouble being porosity, and it rests entirely with those concerned to experiment and to adopt the most suitable method to procure a dust suited to the class of manufacture it is intended for. Dust manufactured under conditions as these is much more satisfactory than "bought-in material," owing to variations, both in cure and quality, occurring in the latter.

Qualities which contain dust can be worked and handled much more easily than qualities without. It facilitates the mixing and possesses the required amount of tack necessary for building up purposes, and yet not enough to prevent the compound being easy and quickly handled. The dust also renders the material solid and able to retain its shape; hence dust is used for producing stamped-out articles, which also can be open cured, thus reducing the cost of production in view of fewer moulds.

Ebonite rod containing dust can also be open cured without resorting to wrapping, which is a great improvement, both from a material and labour point of view.

Naturally in building up a compound in which dust is used, the amount of free sulphur should be estimated in the dust, and the sulphur figure adjusted, as excessive sulphur will cause blooming, which is detrimental to the appearance of the finished product.

Speaking from experience, a dust need not be fully cured up, as long as it has had the necessary time to cure to the point at which it is in a state to enable the material to break up in the fronding operation.

Finally, it cannot be too strongly emphasised that in view of the dust being the all-important product, its manufacture should be strictly standardised down to the minutest detail. The selection of rubber and various ingredients, their cleanliness and freedom from grit, etc., the thickness of sheets for curing, should all be kept constant. The slightest variation is almost certain to lead to trouble, as was shown recently in an important works, where a small change—considered wholly unimportant—having been made in the curing methods, the resultant product produced porosity in the finished articles, a big quantity of which had to be scrapped.—*The India Rubber Journal.*

Poor Outlook for Mexican Guayule Rubber Industry

(By U. S. Consul Chester Donaldson, Torreon, Coahuila)

Owing to the drop in the price of rubber, the guayule rubber industry, formerly of considerable importance in the Torreon district, was of little consequence during the year 1921, all four rubber factories being closed and apparently abandoned, except the Continental Rubber Company, the largest and most important, which owns a million-dollar plant and spent the year 1921 remodeling it and introducing a cheaper system of extracting rubber from the guayule plant, which grows abundantly in the mountains of this district. On January 1 this company again began operations and is still working full force, although, owing to the recent drop in the price of rubber, manufacturing is being carried on at a loss and will continue to operate about two months more, until the stock of guayule plants on hand is used up. If, at the expiration of this period, the price fails to go up to 20 cents or more, this plant will be forced to close down indefinitely. The three other plants, in Gomez Palacio, across the river from Torreon, are now closed and with present prices of rubber have no prospects of opening again unless the market for rubber soon changes for the better.

Editor's Note: Since the above article was written by Mr. Donaldson, the Continental plant at Torreon has been compelled to close down. *See news item on Page 168.*

Rubber Tongue the Latest

A novel although undoubtedly limited use of rubber is seen in a recent report from Paris. During the war Sgt. Vialla was seriously wounded at Verdun. His lower jaw was shot away but clever French surgeons succeeded in reconstructing it with a complete set of teeth. When they had finished the plastic work, the surgeons turned their attention to the veteran's tongue, of which only the base remained.

Dr. Eugene Quenolle after careful study directed the construction of a rubber tongue and palate. To his surprise and delight the veteran was soon able to eat with this mechanism instead of drawing his food through a tube. Afterward he painstakingly trained himself to make sounds. It is now reported that he is able to talk and even sing. Is there any limit to the uses to which rubber may be put?

Rubber Seals for Oil Cans

Texas oil men are studying the possibilities of rubber seals for oil cans. Two types of these seals have recently been patented by the inventors, who claim that the seals can be used very successfully. The seals were exhibited to oil executives at Orange, Texas, during the second week in May.

NEWS OF THE INDUSTRY

The Labor Situation in the Akron Rubber Plants

An effort is now being made by factory managers and labor leaders at Akron to prevent the spontaneous small walkouts which have occured recently in many of the plants from developing into a serious disturbance of the good will between employer and employe.

To this end the Firestone Tire & Rubber Co. on May 29 put into effect an increase averaging 10 per cent in piece-work rates in all departments. It was stated by Mark L. Felber of the Firestone company that this was an additional indication of the renewal of prosperity as it is the first raise in wages this year. On the other hand Firestone tires are now selling on an average of 36 to 51 per cent lower than a year ago. Wages are about 30 per cent lower than the highest paid a year ago.

F. W. Pierce, head of the labor department at the Goodyear Tire & Rubber Co., stated that the men at the Goodyear plant were satisfied as far as he was aware. At the B. F. Goodrich Co. plant employes were protesting the resumption of the 8-hour day without a simultaneous increase in pay such as would maintain the 10-hour scale. This 8-hour day went into effect on the first of the new month. Walkouts at several of the smaller rubber factories have resulted in negotiations between man and employers in which differences have been smoothed out to the evident satisfaction of the men.

Samuel Newman, secretary and treasurer of the organization committee of the Central Labor Union, which is active among Akron rubber workers, expressed the belief that any dissatisfaction existing among the men could be smoothed out by negotiations and that serious dissention could be avoided in the same way. Mr. Newman stated that none of the small walkouts had been ordered by the unions. On the contrary the unions advised against them.

"The dissatisfaction that exists," he said, "is seemingly the cumulative effect of the past reductions in wages and the speeding up of production."

Goodyear Hiring Men

There are now about 1000 more men employed in the Akron plants of the Goodyear Tire & Rubber Co., Akron, Ohio, at present than there were a year ago, according to a recent statement by Goodyear officials. About 2000 have been taken on in the last month.

Zee Zee Rubber Plant Bought by New York Interests

E. D. Newman, 29 Broadway, New York City, representing a group of New York business men whose identities were not disclosed, bought the plant of the Zee Zee Rubber Co., Yardville, near Trenton, N. J., on May 26. The consideration was $58,000. Mr. Newman also bought the home of Irvin Zimmermann, president of the bankrupt firm, which is adjacent to the rubber plant for $6,500. It is said that the interests represented plan to organize a company for the manufacture of tires and tubes.

Kansas City Tire & Rubber Corp. Sold to P. E. Werner

The Kansas City Tire & Rubber Co., Kansas City, Mo., the affairs of which have been in the hands of a receiver since, May, 1919, was recently sold to P. E. Werner, who as the head of the Rubber Products Manufacturing Co. has leased the plant for the manufacture of tires and tubes ever since the receivership. The latter company has recently been reorganized under the laws of the state of Delaware with a capital stock of $500,000.

The Rubber Products Manufacturing Co. will continue to operate the plant. It is planned to increase production of tires to 1000 a day.

Continental Rubber Co. Closes Mexican Plant

The plant of the Continental Rubber Co. at Torreon, Mexico, maintained to produce rubber from the guayule shrub has been closed down, according to a recent report. Other factories in the guayule producing district have also suspended operations for the time being. The low price of crude rubber and unsatisfactory labor conditions are given as the reasons for the closing of the plants.

The work of cutting, baling and shipping the wild guayule shrub to the different factories will continue. Recent surveys show an abundance of the raw material. Thousands of acres that were cut over in the guayule boom ten or fifteen years ago have, reproduced the shrubs. Some shipments of the guayule rubber are still being made to Mexico City where the native product is used for the manufacture of tires.

Rubber Brokers Incorporate

Announcement is made of the formation of the incorporation of Habich & Hammesfahr, crude rubber brokers at 24 Stone street, New York.

W. S. Hammesfahr is president of the company and G. Edward Habich secretary and treasurer. Both have been connected with the crude rubber trade for some time and are favorably known. They will confine their business to transactions between dealers and inmporters of crude rubber and kindred products.

West Haven Rubber Co. Incorporated for $200,000

Articles of incorporation for the West Haven Rubber Co. were filed at Hartford, Conn., May 17 with the secretary of state. The corporation with an authorized capital of $200,000, divided into 2000 shares of $100 each, will manufacture tires and tubes.

The West Haven company, which was organized to take over the business of the Kelley Tire Co. and the Martin Tire & Rubber Co., will turn over to the stockholders of the Kelley company, the $59,000 first preferred non-voting stock in addition to $225,000 in cash as the purchase price. Incorporators of the West Haven company are George F. Armstrong of Rutherford, N. J.; James A. Walsh of New Haven; and Arthur F. Egner of South Orange, N. J.

New Jersey Zinc Co. Opens Office at San Francisco

In keeping with its announced policy to effect the closest possible relationship with customers, The New Jersey Zinc Co. has established a sales office in San Francisco under the name of The New Jersey Zinc Sales Co. This is the third to be opened by that concern during the last four years. The others are located at Pittsburgh and at Cleveland. With the New York and Chicago headquarters, the company now has five selling offices in operation.

The following announcement by E. V. Peters, general sales manager, is of particular interest to the trade: "For the convenience of our customers, we announce that The New Jersey Zinc Sales Co. has been organized for the sale of the various products of the New Jersey Zinc Co. and the Mineral Point Zinc Co. The office and address is The New Jersey Zinc Sales Co., Merchants Exchange Building, San Francisco, California.

"Robert Hursh, district sales manager, will be in charge.

"A well assorted stock of our various pigments will be carried at the Haslett Warehouse, 228 Pine Street, San Francisco, and the Santa Fe Warehouse, 300 Avery Street, Los Angeles, and we suggest that you address communications to the office of the sales company where we can assure you that prompt service will be offered in your territory by the district sales manager."

Scrap Rubber Men to Meet

A meeting of the Scrap Rubber Division of the National Association of Waste Material Dealers, Inc., will be held at the Hotel Astor, New York, on Tuesday, June 20 at 10 a. m. Notwithstanding the very quiet condition of the scrap rubber market, it is expected that the meeting will be largely attended.

New Rubber Company Will Locate at Brockton, Mass

The Brockton Rubber Co., recently organized for the manufacture of rubber heels, gem-duck and cement, has been induced by the local chamber of commerce to locate at the former Stowe & Woodward plant at Brockton, Mass. Renovation and equipment of the plant will begin in a few weeks and it is hoped by officials of the company that production will be under way by midsummer.

It is estimated that the Brockton plant will have a capacity of from 40,000 to 50,000 pairs of heels a day. About 150 persons will be employed.

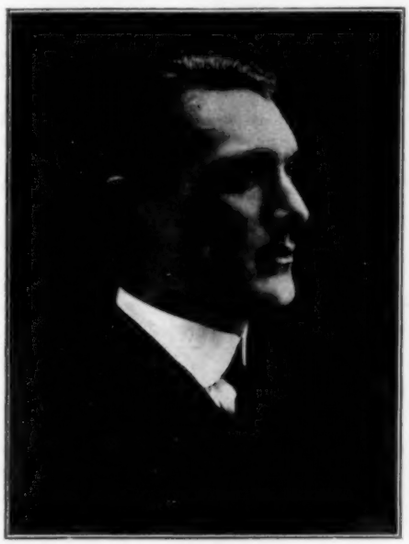
Phil C. Stingel, president of the new company, was formerly president of the Needham Tire Co. Associated with Mr. Stingel in the directorate are Frederick R. Woodward, president of the Stowe & Woodward Co., Newton Upper Falls; Sherman B. Ward, treasurer of the Stow & Woodward Co.; Nicholas J. Mullen, who was with the Boston Woven Hose & Rubber Co. for 29 years, and who spent three years as superintendent of the Plymouth Rubber Co.; and Charles B. Strout, vice president of the Metropolitan Trust Co., Boston, Mass.

Mr. Stingel, in remarking about the decision of the newly-organized company to locate in Brockton, said in part: "There are more than 1,000,000 pairs of rubber heels produced and sold daily in the United States. The demand for a quality heel is steadily increasing with the result that shoe manufacturers are obliged to use rubber heels as standard equipment on new shoes."

Pioneer Rubber Co. to Make Household Gloves

It has been announced that the Pioneer Rubber Co., Willard, Ohio, will undertake the manufacture of a new rubber glove for household and surgical use as soon as another building can be provided. The company has secured the exclusive right to use a patented process in the manufacture of the gloves, which are of a new type, corrugated and self-ventilating; the production cost is said to be one-half that of the ordinary glove.

In a recent announcement to the press, it was stated by an official of the company that more business is offered on some items than can be accepted at present and that orders for balloons for advertising purposes are the heaviest ever experienced. Football orders booked to date for fall delivery are also the heaviest ever experienced. The company is planning the manufacture of several new novelties as soon as extra space can be provided.



ROBERT J. STOKES
Thermoid Rubber Co., Trenton, N. J.

To Build Rubber Plant at Richmond, Virginia

An application for a permit to build a brick plant to cost $25,000 was recently filed with the building inspector at Richmond, Va., by the Virginia-Carolina Rubber Co. The factory will be constructed adjacent to the Southern Railway between Blakely Street and Mill Road.

H. H. Springford Resigns from Goodyear Tire & Rubber Co.

H. H. Springford, who for the past year has been assistant to E. G. Wilmer, president of the Goodyear Tire & Rubber Co., Akron, Ohio, on May 26 tendered his resignation to become effective as soon as possible. Mr. Springford will answer a call to assume the presidency of the Steel & Tube Co. of America.

Personal

George F. Nelson, treasurer of the Chamberlin Rubber Goods Company of Rochester, New York, on May 12 celebrated his fiftieth anniversary with that company.

* * *

Charles W. McLaughlin, vice president and treasurer of the Mohawk Rubber Co., Akron, Ohio, who is a lover of good horses, owned the thoroughbred which led the Shriners' parade in Akron, May 13.

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F. A. Szarvasy, chairman of the Dunlop Rubber Co., Ltd., arrived in New York recently on the White Star steamer Olympic. It is said that Mr. Szarvasy is to arrange for financing the American Dunlop Rubber Co.

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B. G. Work, president of the B. F. Goodrich Co., Akron, Ohio, who returned from Europe recently, spent a few days at the Goodrich offices in Akron several weeks ago. Mr. Work's offices are in New York.

* * *

Joe Murphy, manager of the Houston, Texas, branch of the Firestone Tire & Rubber Co. on May 2 gave a very interesting talk to his sales organization on the lessons learned at the recent Firestone sales convention at Akron. Among those who attended the meeting were Ed Allison, R. L. Urquehart, Gary Gillis, R. W. Kirk, G. H. Anderson, J. W. Evans, Ed Polite, A. B. Spires, L. A. Sneed, H. D. Pierce and Miss F. McCormick, G. Segreider and I. Sonka.

Report of Inventory—Production—Domestic Shipments of Pneumatic Casings—Inner Tubes—Solid Tires

November, 1920 to March, 1922.

"Production" and "Shipment" figures cover the entire month for which each report is made. "Inventory" is reported as of the last day of each month.

"Inventory" includes tires and tubes constituting domestic stock in factory and in transit to, or at, warehouses, branches (if any), or in possession of dealers on consignment basis, and as a total represents all tires and tubes still owned by manufacturers as a domestic stock.

"Shipments" includes only stock forwarded to a *purchaser* and does not include stock forwarded to a warehouse, branch, or on a consignment basis, or abroad.

(Compiled by The Rubber Association of America, Inc.)

MONTH	PNEUMATIC CASINGS				INNER TUBES				SOLID TIRES			
	No. Mfrs. Reporting	Inventory	Production	Shipments	No. Mfrs. Reporting	Inventory	Production	Shipments	No. Mfrs. Reporting	Inventory	Production	Shipments
November, 1920	36	5,880,016	649,742	806,023	40	6,131,935	742,815	920,938	11	298,875	21,355	34,217
December, 1920	43	5,508,380	506,111	1,327,153	43	5,786,929	508,446	1,481,285	12	303,473	16,297	40,828
January, 1921	45	5,319,605	703,430	765,417	47	5,586,163	740,824	1,042,617	12	303,753	21,220	29,116
February, 1921	45	5,193,018	819,892	1,073,756	46	5,415,464	916,627	1,129,881	12	304,374	23,365	29,599
March, 1921	46	4,597,103	1,163,314	1,614,651	48	5,044,861	1,346,483	1,643,690	12	283,800	28,710	43,926
April, 1921	49	4,527,445	1,651,418	1,785,951	51	4,916,772	1,762,122	1,983,571	12	269,985	28,859	42,080
May, 1921	59	4,451,668	2,100,917	2,085,882	57	4,751,880	2,210,040	2,342,567	12	264,663	35,156	40,122
June, 1921	63	4,154,456	2,313,265	2,643,850	60	3,835,098	2,359,928	3,232,673	11	240,336	28,395	49,867
July, 1921	63	3,892,037	2,570,524	2,757,581	61	3,122,815	3,020,981	3,603,248	11	220,003	35,123	55,678
August, 1921	66	3,934,853	3,043,187	2,894,442	64	3,649,319	4,430,152	3,804,060	11	216,367	55,694	66,866
September 1921	63	3,340,798	1,929,268	2,047,929	62	3,827,830	3,274,822	2,645,758	11	161,832	37,441	50,276
October, 1921	64	3,545,030	1,928,271	1,675,169	64	4,732,016	2,843,918	2,016,371	10	163,299	46,274	45,911
November, 1921	64	3,908,342	1,756,555	1,342,519	63	5,203,568	2,126,211	1,540,299	10	173,451	43,537	34,556
December, 1921	64	3,696,519	1,839,738	1,980,264	64	4,731,021	2,070,098	2,522,710	10	168,515	40,478	39,520
January, 1922	66	4,174,216	2,055,134	1,596,806	66	5,246,647	2,343,393	1,889,724	11	181,769	40,224	33,294
February, 1922	66	4,691,329	2,084,308	1,562,365	65	6,141,956	2,596,774	1,702,583	11	183,448	39,492	36,805
March, 1922	63	5,183,286	2,645,790	2,073,963	63	6,991,118	3,017,511	2,090,737	11	182,197	49,433	48,350

Students Visit Rubber Plant

Sixty members of the junior class in mechanical engineering at the Case School of Applied Science, Akron, Ohio, on June 5 visited the plant of the Goodyear Tire & Rubber Co. The students, who were in charge of Professor F. H. Vose, head of the department of mechanical engineering, went through the tire departments during the morning. After lunch at the factory, followed by a moving picture exhibition in Goodyear Hall showing the rubber plantations of the company in Sumatra, the students visited the mechanical goods departments at Plant 2.

The engineering students were welcomed by the Case alumni at the Goodyear plant which includes W. T. Van Orman, W. L. Hain, P. H. Prentice, C. B. Orr, Charles Roth, A B. Blank and H. D. Cameron.

Increases Production and Start New Schedule at Goodrich

For the past few weeks the B. F. Goodrich Company, Akron, Ohio, has been adjusting its working schedules in preparation for a 35 per cent increase in production which was put into effect on June 1. The plant is now on a uniform eight-hour basis. In some departments employes had been working on nine and nine-and-a-half hour shifts.

Officials declare that it may be necessary because of increased business to put some departments on a two-shift basis. For some weeks the company has been gradually adding hands.

DuBois Rubber & Tire Co. Now Operating at Capacity

Production at the plant of the DuBois Rubber & Tire Co., Chattanooga, Tennessee is now reported to be operating at capacity. For the past few weeks production has been increased daily until it now exceeds 500 tubes, divided between the red, gray and compression tubes. The DuBois company specializes in the manufacture of the latter product.

The company was organized to manufacture these compression tubes and the other type of tubes and tires. At first the output of the plant was confined to the production of compression tubes but now both fabric and cord casings are being manufactured in the only rubber plant located in Chattanooga. Distribution of DuBois products has spread to 400 southern cities and towns.

Receivers Report Good Business for Tuscora Co.

Henry Krantz and C. C. Adams, receivers for the Tuscora Rubber Company, Dover, Ohio, recently announced that from present indications a profit ranging from $5,000 to $10,000 would be realized for May. According to the receivers the average output is now about 160 tires, which is the largest production in the history of the plant. Under its former management with a force twice as large as the present one daily production averaged only about half.

If business continues to increase, the receivers said, a double shift will be put on in order to increase production to 300. All goods are being sold for cash only. The installation of a new sales department is being contemplated.

Paul Tire & Rubber Co. Now Producing

The new Paul Tire & Rubber Co., Salisbury, N. C., completed the construction of its plant and began production in the early part of May. The new plant, which is located in the southern part of the city, covers 28,000 square feet and has a production capacity of 500 tires and 1,000 tubes a day. The company expects to eventually employ about 250 hands. In the near future the Paul company plans to open up two new departments for the manufacture of heels and footwear.

Ask Receiver for Nottingham Rubber Company

A bill asking a receiver for the Nottingham Rubber Co., Trenton, N. J., has been filed in the local court of chancery by Samuel H. Bell of Reading, Pa. An order was signed by Vice Chancellor Buchanan which required C. Francis Fisk, of Trenton, an incorporator of the company and an alleged promoter of the defunct Zee Zee Rubber Company, to show cause on May 23 why a receiver should not be appointed.

The Nottingham Rubber Co. was chartered Nov. 2 with an authorized capital of $500,000 to manufacture a patented puncture-proof inner tube. Incorporators were the plaintiff, Samuel H. Bell, president of the company and the holder of 5,000 shares of stock; C. Francis Fisk, who is vice president; and Irvin Alexander, secretary. There are thirteen other stockholders, who have paid in $3,030, in addition to the $5,000 which Mr. Bell paid for his shares. The corporation never progressed beyond the formative stage.

Receiver for Moss Tire & Rim Company Appointed

On the application of Samuel J. Moss, president of the Moss Tire & Rim Co., Dennison, Ohio, Judge W. V. Wright in common pleas court named A. E. Packer as receiver for the company. Assets are given as $1,200 and liabilities at $2,500. Debts and other liabilities which the petition claims the company cannot meet are given as the reason for receivership. Mr Moss says the company has no funds to operate and that persons who subscribed to stock refuse to pay.

Foreign Trade Division Meets

The Foreign Trade Division of the Rubber Association of America met May 9 at the Bellevue-Stratford, Philadelphia, Pa., The monthly meeting which is usually held in New York, was arranged in that city as a matter of convenience to the large number of delegates attending the Foreign Trade Convention. A round-table discussion centered about the subject, "How to Foster the Use of Straight Side tires in Foreign Countries in Preference to the Clincher Type."

F. E. Titus, chairman of the division, presided.

Victor Shows Improvement in Report for First Quarter

A comparison of the operations for the first four months of this year as shown by the quarterly report of the Victor Rubber Company, Springfield, Ohio, with the corresponding quarter last year shows an increase of 17 per cent in the number of tires sold and an increase of 8 per cent in gross profits. Net profits of $42,633 are shown in the report for the four months just past.

It is said that the new Springfield tread now being manufactured in quantity by the Victor company is successfully meeting competition in the small sizes.

Seiberling Rubber Co. Announces Reduction in Tire Prices

The Seiberling Rubber Company, Akron, Ohio, on May 26 through Frank A. Seiberling, president, announced a reduction approximating 12½% in all Seiberling and Portage straight side cords, effective on June 1. The reduction included the absorption by the Seiberling company of the 5% Government Exeise Tax, which dealers had collected heretofore in addition to the regular retail price from the consumer.

In the formal announcement, Mr. Seiberling said in part: "This price reduction is only indicative of the efficiency which may be attained in cord tire manufacture, by concentration on cord tire production with the purpose of making a high quality cord tire, available at a reasonable price to the consumer.

Show Rubber Bathing Suits

An exhibition of the new rubber bathing suits was made a feature of the recent South Dakota Retail Merchants Convention. Mill Della Moody showed the suits as well as the complete 1922 line of rubber hats, crepes and scarfs in the display rooms of the United States Rubber Company at Huron, South Dakota. The new rubber bathing suits are both striking in appearance and color combinations. It was the first time that they had been exhibited in the state.

Racine Horseshoe Tire Co. Reorganized

New officers and directors, elected recently, have taken over the management of the Racine Horseshoe Tire Co. of Racine, Wisconsin. The reorganization of the Racine company was effected through strong eastern financial interests which have a harmonious working arrangement with the stockholders and with the Racine and Milwaukee banks. The new management begins operations therefore with adequate capital and a free hand to go ahead. J. C. Lawrence of the New York banking house of S. W. Straus & Co. is the newly elected president and general manager. Prior to his connections with the Straus interests, Lawrence was for eleven years an officer of the B. F. Goodrich Rubber Co. of Akron.

Other newly elected officers of the Racine company are: O. D. Hollenbeck, vice- president, formerly division superintendent of the Firestone Tire & Rubber Co., Akron; L. H. Shepherd, secretary and sales manager, formerly Indianapolis district manager for the B. F. Goodrich Rubber Co.; Raymond H. Weins of Racine, treasurer. The directors elected are J. C. Lawrence, chairman; H. H. Whiteman, fabric manufacturer, Boston; N. Howard Green, fabric manufacturer, Boston; H. J. Lyall, attorney, New York; Francis J. Johnson, banker of Chicago; W. C. Crawford, banker, New York; J. W. Bate, banker, Racine; F. K. Sivyer, manufacturer, Milwaukee; William O. Goodrich, capitalist, Milwaukee.

American Rubber Co. Closes Department at Cambridge

About 500 employes of the American Rubber Co. were forced out of work when the American Rubber Co. closed its light rubber shoe department at the Cambridge, Mass., plant on May 19. The curtailment of production resulted from a lack of orders for the type of shoes manufactured in the department, according to officials of the company; the shutdown will be for an indefinite period.

At the Cambridge plant about 1500 men and women are employed. The departments which manufacture clothing, arctics, gaiters and sundries will continue to operate for the present on a five-day basis. Production will be increased as soon as orders warrant it.

H. M. Bacon Back with Goodrich

W. O. Rutherford, vice-president in charge of sales of the B. F. Goodrich Rubber Co., has just announced the appointment of H. M. Bacon, to special sales work in the tire division of that corporation.

For several years Mr. Bacon was connected with the B. F. Goodrich Rubber Co., as head of one of its tire sales divisions, and left to accept the vice-presidency of the McGraw Rubber Co., of East Liverpool, Ohio.

Two years ago he became connected with the Thomas Cusack Co., outdoor advertisers, as their Cleveland representative, and it is from there that he comes to Goodrich.

Mr. Bacon's duties will be largely confined to executive direction and development of sales in the tire division where he has an outlet for his wide knowledge and experience.

Receiver for Avalon Rubber Co.

Ray F. Hamlin, former receiver, has been appointed federal receiver for the Avalon Rubber Co., Akron, Ohio, according to B. J. Amer, attorney for the company. Liabilities are believed to amount to between $30,000 and $35,000. An offer to purchase the plant has been made by a group of men interested in radio manufacturing.

Occident Rubber Co. Formed

Articles of incorporation for the Occident Rubber Co. were recently filed at Everett, Wash., showing capital stock of $500,000 and the principal place of business Seattle. A transfer to Beverley Park is provided for. Trustees are H. H. Hazeltine, J. B. Brokaw and A. G. Felsemthal. The plant of the company has been under construction for several months.

Stamford Rubber Supply Co. Announces Its Prize Winners

The Stamford Rubber Supply Co., Stamford, Conn., recently announced the winners in its contest for the best papers on any phase of the general subject—"The Uses of Factice in Rubber Compounding, as follows:

First Prize to A. D. Thornton, Montreal, Canada—Subject "Factice."

Second Prize to S. G. Byam, technical superintendent of The Plymouth Rubber Co., of Canton, Mass.—Subject "Uses of Factice in Proofing."

Third prize to Wellington F. Butler, B.C., of Fairfield, Conn.—Subject "Uses of Factice in Rubber Cements."

Fourth prize to Wm. N. Blodgett, Los Angeles, Cal.—Subject "The Practical Side of the Use of Factice."

Other papers elected by the Judges and retained by the company under the terms of the contest included "Economic Value of Factice in Rubber Compounding" by L. D. Ackerman, Malden, Mass. "The Uses of Rubber Factice in Rubber Compounding" by Michael Berman, Brooklyn, N. Y. "The Advantages of Factice in Rubber Compounding" by Arthur E. Friswell, Jersey City, N. J. "Proofing: Why I Use Stamford Factice" by Hugh J. Greechan, Mamaroneck, N. Y. "Uses of Factice in Proofing" by C. L. Wanamaker, New Haven, Conn. "Rubber Factice in the Manufacture of Rubber Covered Rolls" by Charles Yahraus, Woonsocket, R. I.

To Start Work on Firestone Plant in Canada

The Firestone Tire & Rubber Co., Akron, Ohio, announced recently that work on its new factory to be located at Hamilton, Ontario, Canada, will be started soon so that the plant may be ready for operation by fall. Plans for the new plant, made in 1918, call for a production of 3,500 tires a day. The British government offers special opportunities for foreign trade to factories in Canada and other dominions.

Wishnick-Tumpeer Chemical Co. Opens New Office

The Wishnick-Tumpeer Chemical Co., 365 East Illinois street, Chicago, which handles many of the chemicals used in rubber compounding, announces that it has opened an office and warehouse at Cleveland, Ohio, where a complete stock of industrial chemicals and pigments will be carried for the convenience of the Ohio trade.

C. A. Hemingway, formerly with the Firestone Tire & Rubber Co., will be manager of this office which will be located in the Gund building at Davenport avenue and E. 14th street.

The Career of L. E. Wemple

L. E. Wemple, manager of the American Zinc Sales Co. and the American Zinc Oxide Co., subsidiaries at Columbus, Ohio, of the American, Zinc, Lead and Smelting Co., is originator of the process under which AZO zinc oxides are refined. He has been identified with this company since its inception, and under his able direction the sales and production have been successfully developed.

In 1908 Mr. Wemple was graduated from the Massachusetts Institute of Technology where the excellent training he received well fitted him for the position of superintendent of smelting operations for the Hoyt Metal Co., St. Louis, Mo. He was with this company from 1909 to 1913, resigning to become assistant manager in 1913 of the Caney & Deering Kansas Smelters of the American Zinc, Lead & Smelting Co. From 1914 to 1916 he was chief metallurgist of the American Zinc, Lead and Smelting Co. and its subsidiaries. In 1916 he was made manager of their Zinc Oxide Department and later as incorporated, manager of their subsidiaries the American Zinc Sales Co. and the American Zinc Oxide Co.

Mr. Wemple is a member of the following organizations: American Institute of Mining and Metallurgical Engineers; American Chemical Society; American Society for Testing Materials; American Zinc Institute; and a member of the board of directors of the National Paint, Oil & Varnish Association, in addition to being president of the Columbus club of this association.

He is the author of many papers on the refining of slab zinc and the manufacture and uses of zinc oxide.

Sterling Tire Corp. Doing Good Volume of Business

The Sterling Tire Corp., Rutherford, N. J., reports that conditions in their business have never been so good as at the present time in spite of the chaotic state of business during the past eighteen months.

The corporation reports that they have been materially increasing their production since early in 1921 as well as their personnel. By the middle of this summer it is expected that production will be 1500 tires daily. Since February they have been running their plant on a 24 hour basis at top capacity, which, at present, is 1200 daily. Unless this capacity is considerably increased, it is stated that they will be oversold by July as they are several thousand tires behind orders now.

It is said that increased production, more efficient management and sweeping cuts in selling overhead have made this remarkable progress possible due to decreased prices and increased quality. March sales were larger than any one month in the entire previous history of the company despite the fact that the spring season was just starting. This promises well for the volume of sales of the corporation for the summer months and is indicative of improved conditions in the industry generally.

Jack Tire & Rubber Specializing in Cord Tires

The Jack Tire & Rubber Co., Spokane, Washington, which purchased at sheriff's sale the land, building and machinery of the old Washington Tire & Rubber Co. and which was incorporated under the laws of the state of Washington Sept. 16, 1921, is now specializing in the manufacture of cord tires. Production was begun about the second week in March after extensive alterations had been made in the plant. The Jack company is now averaging an output of 40 tires and 75 tubes a day. The ultimate capacity of the plant is about 500 tires and 1500 tubes in twenty-four hours.

Officers of the company are: T. G. Richards, president and manager; John B. White, secretary and treasurer. W. E. Gree is superintendent.

Republic Rubber Now Has Payroll of 1000

The Republic Rubber Corp. has now a payroll of 1000 hands in its factories at Youngstown and Canton, Ohio, according to a recent statement. About 600 of this number are employed at the Youngstown plant. With the exception of the belting and inner tube departments all departments are working double turn. Demand is so great for tubes that this department is operating triple turn. The belting department is the only one operating on a single shift basis. The molded goods department and the hose department were recently placed on double turn basis.

It is reported that the Republic company is behind in orders to the extent of about 60,000 tubes. Sales of tires also exceed production. Preparations are being made for the resumption of production of tires at the Youngstown plant. At the Canton plant the daily output is about 1800. It is also reported that April sales and net earnings exceeded those of March, and as soon as the May figures can be compiled, it is expected that they will show further improvement.

Spadone Machine Co. at New Location

The Spadone Machine Co., manufacturers of the Bolton Vertical Bias Cutter, have established offices at 15 Park Row, New York. The officers are as follows: W. W. Spadone, president and treasurer; Henry Spadone, vice president; Charles C. Spadone, secretary.

United States Rubber Co. Buys Property at Passaic, N. J.

The United States Rubber Co. has purchased the old Passaic Woolen Mills property at Passaic, N. J., from the Dundee Water Power & Land Co. The consideration named in the deed filed with John R. Norris, county registrar, May 15 was $125,000. The Dundee company also gives the United States Rubber Co. the right to bridge over the canal, from the New York Belting and Packing Co. plant to the property just purchased. The New York Belting company is one of the United States Rubber affiliated firms.

The newly-purchased property has a frontage of 450 feet on the Passaic River and 135 feet on Second street. A strip of property 20 feet wide separates the United States Rubber property from the Dundee Canal.

New Company Formed to Market Rubber Plant Equipment

C. M. White, Jr., for the past four years sales manager of the Firestone Steel Products Co., a subsidiary of the Firestone Tire & Rubber Co., has resigned this position to become president of the newly-organized firm of White & Co., Inc., with offices in the Flatiron building at Akron, Ohio. The company will market material and equipment used in the rubber industry.

Lee Tire & Rubber Co. Report for Quarter Shows Gain

The report of the Lee Tire & Rubber Co., Conshohocken, Pa., for the quarter ending March 31 shows a net profit after all charges of $139,360. This is equal to 92 cents a share on the outstanding capital stock and contrasts favorably with a net profit of 52 cents a share or $77,742 for the corresponding quarter last year.

The May Meeting of the Mid-West Rubber Association

The regular monthly meeting and luncheon of the Mid-West Rubber Manufacturers' Association was held at the Hotel Morrison, Chicago, on Tuesday, May 9, with a large attendance.

After the luncheon the principal speaker, Homer Buckley, Chicago, gave an interesting talk with much valuable information regarding credit accounts and sales. Holding customers after you get them was the subject of his talk. He emphasized that firms should keep a close watch of their ledgers and follow up inactive accounts to determine the cause of their falling off. Much harm can come to a concern from a dissatisfied customer, he said, and in these stressed times it was essential to deliver one hundred per cent service all the time.

During the address he stated that creative and intensive selling is necessary on a steadily falling market which will be the case for the next six years, although high prices do not accompany prosperity in his belief. Mr. Buckley asserted that figures show 75 per cent of the customers will not complain of bad service but will quit a concern cold. Inattention or a slight discourtesy on the part of an employe will often lose a good customer for a firm, he added, and so it is vitally necessary to constantly turn the pages of your ledger in order to keep close track of inactive accounts.

The tire fabric situation was then discussed. G. M. Parker of the Salamon Falls Manufacturing Co., Boston, Mass., reported business in this line very good, and business for the year better than in 1920. In his belief existing conditions seem to indicate a steady rise in cotton prices especially if much buying is done on the present diminished supply.

E. G. Welch of the All Metal Valve Co., Detroit, introduced the Holt Valve, and explained its qualifications.

At the Board of Directors meeting a resolution passed at the April meeting of the Chicago Tire Dealers Association was read, which recommended to all tire manufacturers to adopt a policy of leaving the serial numbers on all tires, and that such tires deemed as seconds, or unfit to carry the guarantee, be branded with the word "second." This method will aid the police and dealers to identify tires in the event they are stolen, otherwise, the removal of the serial numbers causes the dealer to suffer a loss which is not covered by any insurance.

The Marvel Tire & Rubber Co., Syacmore, Ill., was elected to regular membership.

Report Assets of Avalon Co.

The debts of the Avalon Rubber Co., of Akron and Barberton, which has been adjudged bankrupt on a petition filed by three firms, are reported as approximately $35,000 with assets between $25,000 and $30,000.

MARKETS

Cottons and Fabrics

NEW YORK, JUNE 3, 1922

Cotton prices continued to advance during the last two weeks of May and were well maintained above the 20 cent level. Middling Uplands reached 21.50. During the past month the price of raw cotton advanced more than 3 cents a pound and the readjustment of values since last fall represents 5 cents a pound. Fabrics have also advanced but not in proportion to the increase of the raw material. Interest is now centered in the government report to be made early this month.

The large increase in the foreign demand for cotton was a surprise as exports of the staple showed an advance of nearly 33 per cent over the shipments of the preceding month and almost doubled the exports of April a year ago. The figures compiled by the Department of Commerce reported the exports for May as 612,659 bales against 461,484 in April and 319,933 in April a year ago. Domestic consumption declined during April when 446,843 bales were used against 518,450 in March. In April a year ago 409,247 bales were consumed.

Cotton spinning activity showed a marked decrease in April as compared with March and with April in 1921. There were 6,635,666,969 active spindle hours during April compared with 7,779,380,703 in March this year. The average number of spindles operated during April was 30,921,094 as compared with 33,117,840 for March this year.

More than 60 per cent of all the cotton consumed in the world is grown in the United States. The largest single item in consumption is the tire industry which takes over 500,000 bales.

Cotton prices as of June 2 on the New York Cotton Exchange follow:

	Open.	High.	Low.	Close.	Prev. day.
July	20.47	20.85	20.16	20.82@20.83	20.46
Oct.	20.18	20.60	19.95	20.52@20.60	20.13
Dec.	20.02	20.40	19.80	20.39@20.40	19.99
Jan.	19.80	20.16	19.65	20.12@20.16	19.84
March	19.62	20.00	19.50	19.92@20.00	19.62

PIMA COTTON

There is still considerable interest in Pima cotton even at the high prices. Some large sales have been reported and some grades are getting scarce. It is said that nearly two-thirds of the supply of Pima has been sold and that it is difficult to buy No. 3 grade in quantity. No. 1 is held around 31 to 32 cents and 1 cent higher for spots; No. 2 can be had for 33½ to 34½ cents and as high as 36 cents is being asked for spots; No. 3 is quoted around 31 cents to 32 cents.

EGYPTIAN COTTON

There has been a continued improvement in prices of Egyptian especially for medium uppers. Medium grade Sak suitable for tire yarn purposes has been selling steadily and in good volume around 41 to 43 cents, tariff paid. The following prices have been quoted: No. 10, 28 cents; No. 12, 27¾ cents; No. 14, 27 cents. Medium sakels are quoted at 34½ cents for No. 49; 37 cents for No. 46 and 39 cents for No. 42.

TIRE FABRICS

The tire fabric trade has been quite active and sizable orders have been put through during the last week. Recent reductions in the prices of tires have stimulated sales, made way for new production and brought about increased business in both cord and square woven fabrics. The following quotations give a fair idea of prices heard in the trade in a range largely governed by the staple used.

CORD FABRICS

Combed Sakellarides	lb.	.80	@	—
Carded Sakellarides	lb.	.80	@	—
Combed Peeler	lb.	.67½	@	.75
Carded Peeler	lb.	.50	@	.60
Combed Egyptian uppers	lb.	.70	@	.75
Carded Egyptian uppers	lb.	.65	@	.72½

SQUARE WOVEN

17¼-ounce Egyptian uppers, combed	lb.	.65	@	.72
17¼-ounce Egyptian uppers, carded	lb.	.60	@	.67
17¼-ounce Sakellarides, combed	lb.	.75	@	.78
17¼-ounce Sakellarides, carded	lb.	.70	@	.73
17¼-ounce Peeler, combed,	lb.	.62½	@	.70
17¼-ounce Peeler, carded	lb.	.50	@	.55

Will Standardize Duck

At a meeting held in the offices of the Association of Cotton Textile Merchants of New York, a joint committee of the Cotton Duck Association, the Cotton Manufacturers Association, the National Association of Tent and Awning Manufacturers, the Association of Cotton Textile Merchants of New York and representatives of the Bureau of Standards, the matter of preventing trade abuses in the cotton duck trade was discussed. A report of measures to be taken to elevate the standard of ethics in merchandising duck will be made at the next meeting to be held in the near future. The suggestion was made that in establishing a standard for the manufacture and sale of duck a square yard be made the basis of weight.

SHEETINGS—DUCKS—BURLAPS

Sheetings—The continued rise in cotton has materially strengthened this market. The buying has been more general and broader and a much greater degree of confidence in values and in general prospects prevail. For 40 inch, 3.75 yard, 9½ cents net was asked; 8½ cents net for 40 inch, 4.25 yard; 11½ to 11¾ cents net for 40 inch, 2.85 yard.

Ducks—Reported to be moving in better quantities with prices holding up. Orders are not large but large factors in the trade feel encouraged over the improvement since a month ago. Single filling was quoted at 15½ at 17 cents; double filling, 17½ at 18 cents; enameling at 38 cents.

Burlaps—The burlap market continued strong all through the period with sharp advances on cabled reports from Calcutta of crop scarcity and the small carry-over from the current crop. At times the advance in prices was violent; 8 and 10½ ounce stock advancing ½ cent a yard during the day.

SHEETINGS

40-inch 2.50-yard	yd.	.13¾	@	—
40-inch 2.85-yard	yd.	.11½	@	.11¾
40-inch 3.15-yard	yd.	.13½	@	—
40-inch 3.60-yard	yd.	.10¼	@	.10½
40-inch 3.75-yard	yd.	.09½	@	—
40-inch 4.25-yard	yd.	.08½	@	—

DUCKS

Belting	lb.	.31	@	—
Hose	lb.	.31	@	.34
Enameling	lb.	.38	@	—
Shoe Ducks	lb	.40	@	—
Single filling	lb.	.15½	@	.17
Double filling	lb.	.17½	@	.18

BURLAPS
(Carload Lots)

7 -ounce 40-inch	yd.	5.35	@	7.05
7½-ounce 40-inch		7.15	@	7.25
7½-ounce 45-inch		8.05	@	—
10 -ounce 40-inch		10.30	@	10.50
10 -ounce 36-inch		9.40	@	—
8 -ounce 40-inch		7.25	@	7.40
10 -ounce 45-inch		11.05	@	—
10½-ounce 40-inch		10.50	@	10.60

DRILLS

37-inch 3.25-yard	yd.	.10¾	@	—
37-inch 2.75-yard	yd.	.12½	@	—
37-inch 3.00-yard	yd.	.11¼	@	—
37-inch 3.50-yard	yd.	.10¼	@	—
37-inch 3.95-yard	yd.	.09⅝	@	—

OSNABURGS

30-inch 7-ounce		.11½	@	—
40-inch 7-ounce		.12	@	.12½

ALEXANDRIA

May 5, 1922

	Receipts Alexandria Cantars	Exports in Bales to England	Continent	America	Total Exports Cantars	Stock Alexandria Cantars
This week	53,083	3,369	660	1,125	38,550	2,209,913
Same week 1921	134,825	5,928	5,434	1,178	96,154	1,893,427
" " 1920	25,112	2,161	1,043	1,671	38,590	876,605
Since 9/1/1921	4,778,247	257,676	171,432	149,363	4,403,334	—
Same time 1920	3,945,018	163,793	117,054	39,541	2,449,793	—
Same time 1919	5,505,176	318,497	115,226	237,526	5,071,571	—

Chemicals and Compounding Ingredients

THE INDUSTRIAL CHEMICAL MARKET, JUNE 3, 1922—The first week of the period under review saw the chemical market broaden and prices in general rise to higher levels. There was no urgent demand and the price movement was suggestive of the sharp advance in prices that might accompany any heavy demand in a market where the supplies of goods are far lighter than usual. The cut in freight rates in effect July 1 will benefit the domestic producers, especially those whose plants are at some distance from the market. It will permit them to come into the market under more favorable terms in competition with the foreign producers. There was a cessation of activity during the last days of the month and consumers were content with satisfying their immediate needs.

ACCELERATORS

Organic

Aldehyde			
ammonia, crystals	lb.	$ .95 @	.98
Aniline oil, bulk basis,	lb.	.16½ @	.19
Excellerex,	lb.	.40 @	.45
Formaldehyde-Aniline	lb.	.50 @	—
Hexamethylene-tetramine (powdered)	lb.	.72 @	.75
Paraphenylenetramine	lb.	1.60 @	1.70
Thiocarbanilide	lb.	.28 @	.40
Vulcocene	lb.	.35 @	—

Inorganic

Lead, dry red bbls.	lb.	.08¾ @	.10
Lead, white, basic carbonate	lb.	.07 @	.07½
Litharge, domestic	lb.	.08 @	.08¼
imported	lb.	.17 @	—
Lime, Superfine	lb.	.02¼ @	.02½
Magnesium, calcined,			
light,	lb.	.24 @	.25
extra light	lb.	.45 @	—
heavy	lb.	.05½ @	.07½

COLORS

Blacks

Carbon Black	lb.	.13 @	.20
Micronex	lb.	.14 @	.24
Lamp black	lb.	.17 @	.45
Bone "	lb.	.05½ @	.07½
Drop "	lb.	.07½ @	.16
Ivory "	lb.	.15 @	.45

Blues

Prussian	lb.	.50 @	.60
Ultramarine	lb.	.08 @	.35
Cobalt	lb.	.21 @	.25

Browns

Iron oxide	lb.	.05 @	.06
Sienna, Italian, raw and burnt	lb.	.05½ @	.14
Umber, Turkey, raw and burnt	lb.	.04 @	—

Greens

Chrome, light, c. p.	lb.	.30 @	.32
medium	lb.	.35 @	.36
dark	lb.	.36 @	.45
commercial	lb.	.12 @	—
Rubber Makers Green	lb.	3.50 @	—

Reds

Antimony, crimson	lb.	.21 @	.24
golden	lb.	.20 @	.44
red sulphuret	lb.	.20 @	.22
Indian, English, pure	lb.	.12 @	.15
Para toner	cwt.	1.25 @	1.40
Rubber makers red	lb.	3.50 @	—
purple	lb.	2.50 @	—
Toluidine tone	lb.	2.10 @	—
Tuscan red	lb.	.17½ @	.35
Venetian red	lb.	.03½ @	.06½
Vermillion, quicksilver, English	lb.	.90 @	.95
domestic	lb.	.25 @	.30

Whites

Albalith	lb.	.06 @	.06½
Aluminum bronze	lb.	.55 @	.60
Azolith	lb.	.06 @	.06½
Lithopone, domestic (factory)	lb.	.06¼ @	.06½
Zinc oxide.			
American Horse Head Special	lb.	.08 @	.08½
XX red	lb.	.07½ @	.08
American Azo:			
ZZZ (lead free)	lb.	.07½ @	.08
ZZ (under 5 per cent leaded)	lb.	.07¼ @	.07¾
Z (8-10 per cent leaded)		.07 @	.07½
Zinc oxide, French process, White seal	lb.	.11 @	.11¼
Green seal	lb.	.09¾ @	.10¼
Red seal	lb.	.08¾ @	.09¼

Yellows

Cadmium sulphide	lb.	1.60 @	1.70
Chrome, light, c. p.	lb.	.16½ @	.17
dark	lb.	.16½ @	.17
medium	lb.	.16½ @	.17
Ocher, French	lb.	.03 @	.04½
domestic	lb.	.02½ @	.03
Rubber Makers' Yellow,	lb.	3.50 @	—

COMPOUNDING INGREDIENTS

Aluminum flake	ton	25.00 @	29.50
hydrate	ton	19.00 @	21.00
Ammonia carbonate,	lb.	.08¾ @	.09¾
Barium carbonate	ton	60.00 @	62.00
Barytes, southern off-color,	ton	.15 @	.17
Western, prime white,	ton	23.00 @	—
Basofor	lb.	.04½ @	—
Blanc fixe, dry, f.o.b. works	lb.	.04¼ @	.04½
Chalk, precipitated, extra light	lb.	.03 @	.03¾
heavy	lb.	.02½ @	.03¼
Clay, China, domestic,	ton	15.00 @	16.50
imported	ton	16.00 @	22.00
Dixie	ton	22.00 @	32.00
Blue Ridge	ton	22.00 @	32.00
Fuller's Earth, powdered	ton	23.00 @	25.00
Fossil flour	ton	60.00 @	—
Glues, extra white	lb.	.30 @	.40
medium white	lb.	.20 @	.26
cabinet	lb.	.18 @	.30
cabinet low grade	lb.	.15 @	.18
common bone	lb.	.08½ @	.14
Graphite flake, bbls.	lb.	.06½ @	.12
powdered	lb.	.04 @	.10
Infusorial earth, powdered	ton	60.00 @	—
bolted	ton	65.00 @	—
Mica, powdered	lb.	.10 @	—
Rotton Stone (powdered)	lb.	.02½ @	.04½
Silica (aluminum)	ton	22.00 @	23.00
Soapstone, powdered	ton	12.00 @	—
Starch, powdered corn	cwt.	2.22 @	2.50
Talc, domestic	ton	15.00 @	18.00
French	ton	22.50 @	30.00
French, high grade	ton	40.00 @	45.00
Italian,	ton	44.00 @	55.00
Terra Alba, American No. 1	cwt.	1.85 @	2.00
American No. 2	cwt.	1.25 @	—
Tripoli	lb.	.02½ @	—
Whiting, commercial	cwt.	1.10 @	—
Quaker	ton	13.00 @	15.00
English cliffstone	cwt.	1.70 @	1.90
gilder's bolted	cwt.	1.15 @	1.25
Paris white American	cwt.	1.35 @	1.45
Zinc Oxide—			
5 per cent leaded		.07¼ @	.07¾
10 per cent lead sulphate	lb.	.07 @	.07½
20 per cent lead sulphate	lb.	.07 @	.07½
35 per cent lead sulphate	lb.	.07 @	.07½

(Also see whites)

MINERAL RUBBER

Gilsonite	ton	70.00 @	—
Genasco (factory)	ton	50.00 @	—
Hard hydrocarbon	ton	32.00 @	45.00
Soft hydrocarbon	ton	30.00 @	35.00
Pioneer M.R.	ton	42.00 @	44.00
320 M. P. hydrocarbon (c. l. factory)	ton	45.00 @	50.00
300/310 M. P. hydrocarbon (c. l. factory)	ton	40.00 @	45.00
Synpro, granulated, M.R. (factory)	ton	54.50 @	70.00

SOFTENERS

Acids

Acetic, 28 per cent	cwt.	2.35 @	2.50
Carbolic (phenol)	lb.	.12 @	.18
Cresylic, 97 p.c.	lb.	.53 @	.55
95 p.c.	lb.	.48 @	.53
Muriatic, 20 degress	cwt.	1.10 @	1.25
Nitric, 36 degrees	cwt.	5.00 @	6.00
Sulphuric, 66 degrees	ton	16.00 @	17.00
60 degrees, bulk	ton	10.00 @	12.00
Tartaric, crystals	lb.	.30 @	—

Alkalies

Caustic soda, 76 p.c.	cwt.	3.90 @	4.00
Soda ash, 58 p.c.	cwt.	2.15 @	2.20

Oils

Castor, No. 3, bbls.	lb.	.10½ @	—
Corn, crude, bbls.	lb.	.11½ @	—
refined	lb.	.13 @	—
Chinawood, bbls.	lb.	.13½ @	.14
Cottonseed,	lb.	.10 @	—
Glycerine, drums	lb.	.15 @	.16
Linseed, domestic	lb.	.87 @	.88
imported	lb.	.82 @	.83
Palm, Niger		.06⅛ @	.06¼
Lagos	lb.	.07⅛ @	.07¼
Peanut, domestic, crude	lb.	.12 @	.12¼
Pine, steam distilled over 930° sp. gr.	gal.	1.00 @	1.05
Rapeseed, refined	gal.	.82 @	.84
blown	gal.	.92 @	.93
Rosin, first rectified	gal.	.37 @	—
second rectified	gal.	.39 @	—
Tar, commercial	gal.	.31½ @	—
Soya Bean, crude, bbls.	lb.	.11¼ @	.11½
" " refined	lb.	.11¾ @	.12

Resins and Pitches

Cumar resin, hard	lb.	.09 @	.12
Cumar resin, soft	lb.	.09 @	.12
Tar Retort	bbl.	9.00 @	—
kiln burned	bbl.	9.00 @	—
Pitch, Burgundy	lb.	.05 @	.06
coal tar	ton	.01½ @	—
pine tar		.03½ @	—
Rosin, grade K	bbl.	6.20 @	—
Strained	bbl.	6.00 @	—
Shellac, fine organe	lb.	.85 @	—

Solvents

Acetone, drums,	lb.	.08 @	.11
Alcohol, denatured, No. 1 bbls.	gal.	.30 @	.32
Methyl, 95 per cent, drums	gal.	.52 @	—
Benzol, 90 per cent	gal.	.30 @	.35
pure	gal.	.29 @	.34
Carbon bisulphide,	lb.	.06 @	.07
tetrachloride	lb.	.09½ @	.10½
Dimethylaniline	lb.	.35 @	—
Motor gasoline, steel bbls.	gal.	.24 @	—
Toluol, pure	gal.	.30 @	.35
Turpentine, spirits	gal.	.99½ @	—
wood	gal.	.78 @	.80
Xylol, pure	gal.	.45 @	.51
commercial	gal.	.34 @	.39

Waxes

Beeswax	lb.	.36 @	.38
sun bleached	lb.	.45 @	—
Caranuba, No. 1	lb.	.16 @	—
Ceresin, white	lb.	.09 @	.10
Bayberry	lb.	.21 @	.22
Montan, crude	lb.	.05¼ @	.05¾
Ozokerite, black,	lb.	.22 @	.23
Paraffine	lb.	.05 @	—
Petrolatum, amber, bbls.	lb.	.04½ @	—
dark amber,	lb.	.04 @	—

SUBSTITUTES

Black	lb.	.08½ @	.14
White	lb.	.09 @	.16
Brown	lb.	.10 @	.14
Brown factice	lb.	.08 @	.14½
White factice	lb.	.09 @	.15½

VULCANIZING INGREDIENTS

Lead, black hyposulphite (black hypo)	lb.	.42 @	—
Orange mineral, domestic	lb.	.11¾ @	.13¾
Sulphur chloride (jugs)	lb.	.20 @	—
Sulphur flour pure	bbl.	2.60 @	3.10
Bergenport pure	cwt.	2.55 @	—
superfine, 99½ p.c.	bbl.	2.40 @	2.90

Zinc Oxide—Notwithstanding the advance in the basic raw material prices remain unchanged. Imported oxide continues to come in but not in quantities sufficient to disturb American producers. Quotations follow: 5 per cent lead, 7¼ at 7¾ cents; 10 per cent, 7 at 7½ cents; 20 per cent 7 at 7½ cents; 35 per cent, 7 at 7½ cents.

Litharge—The call for this material has only been fair. There was an advance of ¼ cent on dry in casks during the period but other items remained the same. These quotations were heard: In casks 8¼ at 8½ cents per pound; 100 pound kegs, less than 500 pounds, 12.35 cents; 500 to 2000 pounds, 11.02 cents.

Lithopone—Big producers are working their plants day and night to meet the demand notwithstanding that the amount of imported material coming in continues large. There was no change in quotations, domestic in bags bringing 6 cents per pound; car lots, 6¼ cents; less than carlots 6½ cents.

Caustic Soda—The market was very firm and some producers found it difficult to keep up with the demand. Standard brands could be had at $3.75 in less than car load lots.

Soda Ash—There has been no important change in the market. Leading producers quote 58 per cent in barrels, $2.00 at $2.10. Demand has been along broad lines.

Carbon Bisulphide—There has been a good demand from the rubber trade and prices have held firm. Supplies were not any too great and quotations were steady at 6 at 7 cents per pound. Sales have been far ahead of previous years.

Orange Mineral—Upon a good demand for this material prices advanced somewhat, domestic being quoted at 11¾ at 13¾. Imported was not in demand and was quoted: French, 15 cents; German, 14 cents.

Barytes—There were no price changes and only a routine demand. Prime Western contiues at $23 per ton, point of production. The reduction in freight rates which goes into effect in July is expected to help the producer.

Blanc Fixe—Prices were firm and the demand fully up to the season. Dry was quoted at 4¼ at 4½ cents per pound and pulp at $40 at $50 per ton.

Palm Oil—There was a fair inquiry for both Lagos and Niger. The market for the former was steady at 7⅛ at 7¼ cents and Niger was quoted at 6⅛ cents.

Soya Bean Oil—Supplies for spot continue extremely small. Inquiry was good. July arrival was offered at 10½ cents per pound, duty paid at New York. May-June shipments were quoted at 10¼ cents.

Whiting—The demand is steady and stocks in consumers hands are not large. Prices continued firm without any particular change during the period. Quotations were as follows: Commercial, $1.10 per hundred pounds; American paris white, $1.35 at $1.45; English cliffstone, $1.70 at $1.90; gilders' bolted, $1.15 at $1.25; extra gilders' bolted, $1.25 at $1.35.

Talc—Producers of talc will be favorably affected by the new freight rates. Foreign material continues to come into the market quite freely and is absorbed in the general demand. Domestic is quoted at $15 at $18 per ton; French, $22.50 at $30.00 per ton; high grade French, $40 at $50 per ton; Italian, $44 at $55 per ton.

Crude Rubber

NEW YORK, JUNE 2, 1922

Since our last report the status of the crude rubber market has perceptively weakened. During the past fortnight prices for some of the plantation grades fell as low as fourteen cents but have now recovered somewhat although the New York market does not compare favorably with that of London and Singapore where better prices are being experienced. It is said that one of the causes influencing the market here has been liquidation in London, resulting in the selling of large dealers in New York.

There are good stocks of practically all grades but manufacturers are buying only for current needs. Sales reported are small although they aggregate a fairly large tonnage. Sellers are restricting their offerings to moderate quantities and few large blocks have been offered.

In some quarters it is both hoped and expected that better business will be experienced after this month.

Stocks in London are only slightly larger than they were a year ago. For the second week in May the landings amounted to 1250 tons and the deliveries 916 tons, leaving a stock of 68,934 tons which compares with 69,158 tons a year ago.

Quotations of this date are practically as follows:

Plantations			
Ribbed Smoked Sheets and First Latex, spot	.15¼	@	.15¾
June	.15	@	.15¼
July	.15¼	@	.15¾
July/December	.16	@	.16¼
October/December	.16¼	@	.16½
Smoked sheets plain, spot	.14	@	.14¼
First Latex Pale crepe, spot	.15½	@	.15¾
June	.16	@	.16¼
July/September	.15½	@	.15⅝
July/December	.16¾	@	.17
October/December	.17	@	.17¼
Amber Crepe No. 1	.14½	@	.14¾
" " " 2	.14½	@	.14¾
" " " 3	.13¾	@	.14
Light clean thin brown crepe	.14¼	@	.14½
Commercially Clean thin brown crepe	.13¾	@	.14
Roll Brown Crepe, spot	.11	@	.11¼
Paras			
Madeira Fine	.21	@	.21¼
Acre Fine	.18⅛	@	.18½
Up-river Fine	.18	@	.18¼
Up-river Medium	.16½	@	.16¾
Up-river Caucho ball (shipment)	.13¼	@	.13½
Up-river Coarse	.12½	@	.12⅝
Islands Fine	.17	@	.18
Islands Medium	.15¾	@	.16
Islands Coarse	.08	@	.08½
Cameta	.09¼	@	.09½
Xingu Ball	.10¾	@	.11
Tapajos fine, spot	.17	@	.17½
Pontianac			
Prime Pressed	.11½	@	.12
Plantation	.06½	@	.06¾
Bangermassin	.07¼	@	.07½
Palembang	—	@	.08½
Siak Gutta Percha	.14¾	@	.15
Prime Macassar	2.85	@	2.90
Balata			
Panama Block	.35	@	.40
Surinam Sheets	.67	@	.70
Columbia Block	.43	@	.44
Venezuela Block	.51	@	.52

Reclaimed Rubber

NEW YORK, JUNE 2, 1922

During the last fortnight there has been very little change in the reclaimed rubber market. Reclaiming plants continue to operate at about one-quarter capacity. Practically no new orders are reported even for the better grades. Reclaimers do not expect any immediate change for the better.

Quotations of this date are nominally as follows:

Standard Reclaims			
Floating	$.12	@	$.13
Friction	.12	@	.13
Boots and Shoes	.09	@	.10
Boots and Shoes (washed)	.13	@	.14
Mechanical	.08	@	.10
Hose	.10½	@	.11½
Tires, truck	.09	@	.10
Tires, auto	.09	@	.10
White	.13	@	.14

Scrap Rubber

NEW YORK, JUNE 2, 1922

The scrap rubber situation remains about the same since our last report. Few orders are reported for any of the grades in the eastern states and there is virtually no activity even insofar as prices are concerned. Mills in the east are not buying and the accumulation of waste rubber is growing larger each week. What activity there is in the scrap rubber trade is centered about Akron and the smaller Ohio industrial rubber centers. Eastern dealers find it impossible at existing prices to compete with the dealers in Ohio due to the freight rates which add 15 cents to the prices of each hundred pounds.

Quotations of this date (per pound in carload lots delivered) are as follows:

Auto tire peelings	.01⅛	@	.01¼
Standard White auto	.01	@	.01⅛
Mixed auto	.00½	@	.006/10
Bicycle tires	.00½	@	.00⅝
Clean solid truck tires	.00⅜	@	.00⅞
Boots and shoes	.02¼	@	.02⅝
Arctics, trimmed	.00¾	@	.02
Arctics, untrimmed	.01	@	—
Inner tubes, No. 1	.03	@	.03¼
Inner tubes, compounded	.02½	@	.02⅝
Battery jars, black compounded	Nominal		
Battery jars No. 1 bright fracture	Nominal		
Inner tubes, red	.02⅝	@	.02⅞
Heels and pads	Nominal		
Black mixed	.00¼	@	.00⅜
Garden hose	.00½	@	.00⅝
Air brake hose	.00½	@	.00¾
Red packing	.01	@	.01¼
Red mixed rubber	.01¾	@	.02
White mixed rubber	.01¾	@	.02

American Rubber Patents

1,414,640 Takebe Hase, San Francisco, Calif. Rubber Collar.

1,414,543 Frank E. Bessler, Akron, Ohio. Tire.

1,414,478 Willard M. McEwen, Chicago, Ill. Tire-Casing Filler.

1,414,507 John R. Gammeter, Akron, Ohio, assignor to The B. F. Goodrich Company, New York. Vulcanizing Apparatus.

1,415,468 Hermann Plauson, Hamburg, Germany. Process for Manufacture of Rubber-Like Substances.

1,415,724 Cheri M. Sloman, Detroit, Mich. Tire-Building Apparatus.

1,415,755 Edward Wright, Dayton, Ohio. Tire Core.

1,415,557 Robert Heller, Brooklyn, New York, assignor to Stanley Tire & Rubber Corp. of Delaware. Tire Mold.

1,415,140 Edward M. Beckman, Gary, Ind. Pneumatic Tire.

1,415,604 William W. Moore, Spokane, Wash. Pneumatic Tire.

1,415,283 Herbert N. Wayne, Washington, D. C. Inner Tube for Automobile Tires.

1,415,842 Robert W. Snyder, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio. Apparatus for Building Tires of the Solid Type.

1,415,082 Edward E. Allen, Erie, Pa., assignor to Allen Machine Co., Erie, Pa. Vulcanizing Press.

Trade Marks Applied For

[The following are trade-mark applications pertinent to our field pending in the United States Patent Office which have been passed for publication and are in line for early registration unless opposition is filed promptly. For further information address National Trade-Marks Company, Barrister Building, Washington, D. C. or Bush Building, 130 West 42 Street, New York, trade-mark specialists. As an additional service feature to its readers this Journal gladly offers to them an advance search free of charge on any mark they may contemplate adopting or registering.]

SANTA LUCIA, above diamond bearing words "EVER-WEAR" HEEL—No. 157,694. Samuel Santalucia, Waterbury, Conn. For rubber heels.

OLIVITE—No. 158,690. Oliver Sherwood Co., San Francisco, Calif. For Comparatively Hard and Nonbreakable Material Suitable for Making Various Articles of Manufacture, Said Material Being a Composition of Matter Essentially of Rubber and Made by a Secret Formula.

NUBBER—No. 157,588. Rubber Process Corporation, Detroit, Mich. (For) Rubber Preservative.

MASTER—No. 159,168. The Manhattan Rubber Mfg. Co., Passaic, N. J. For Rubber Soles and Rubber Heels.

LACROSSE RUBBER MILLS CO., LACROSSE, WIS., on the rim of circle with star in center. No. 154,655. Lacrosse Rubber Mills Co., Lacrosse, Wis. For Rubber Boots and Shoes.

WENTWORTH'S, with each letter arranged in series of steps with a candle at the top. No. 152,153. Wentworth Clothing Company, Spokane, Wash. For Men's, Young Men's and Boys' Haberdashery—Namely Rubber Shoes, and Combinations of Rubber and Fabric Shoes.

SNUG ARCH SHOE—"The" in panel across the letters "SNUG" and "Arch" over "Shoe", all within a rectangle. No. 147,913. Churchill & Alden Co., Brockton, Mass. For Shoes and Boots of Rubber for Men, Women and Children.

BERGOUGNAN TIRES, on rim of yellow disc with word "Trenton, N. J." in panel across center. No. 159,135. Bergougnan Rubber Corporation, Wilmington, Del., and Trenton, N. J. For Rubber Tires.

SUPERBILT—No. 155,305. Funsten Brothers & Company, St. Louis, Mo. For Tubes for Pneumatic Tires.

BUOYANT, across a circle with bands supporting an irregular circle. No. 157,643. L. Q. White Shoe Co., Bridgewater, Mass. For Rubber heels.

HOPPER, on panel with picture of a family of frogs. No. 158,196. Paul A. Savi, Boston, Mass. For Boots and Shoes of Leather, Rubber, Fabric, and combinations.

ADAPTO—No. 157,840. Louis A. Leopold, trading of Lane Bryant, N. Y. City. For shoes of leather, rubber fabric, and of the combination of the foregoing.

New Incorporations

CALIFORNIA

Coast Tire Sales Co., to deal in rubber goods. $500,000. Principal office, SanFrancisco, California. Representative, G. C. Calden, San Francisco, California.

DELAWARE

Maryland and Delaware Rubber Co. $25,000. Incorporators: Daniel O. Hastings, C. A. Southerland and S. F. Coursen. Representative, D. O. Hastings. Principal office, Wilmington, Delaware.

Times Square Auto Supply Co., to deal in tires etc. $3,400,000. Principal office, Wilmington, Delaware. Agent, Corporation Trust Co. of America.

Century Machinery Corporation, to manufacture articles of rubber. $5,000,000. Incorporators: M. Lucey, M. B. Reese, and L. S. Dorsey—Wilmington, Delaware. Delaware agent: Colonial Charter Co., 927 Market street, Wilmington, Delaware.

The Toledo Mutual Supply Co., to deal in tires. 1100 shares of stock, no par value. Incorporators: C. M. Fyler, 714 Oakwood avenue; M. C. Paquette, 603 West Central avenue; G. R. Huntley, 1327 Parkside Boulevard—Toledo, Ohio. Principal office, Toledo, Ohio. Delaware agent, Capital Trust Co. of Delaware, Dover, Delaware.

Dollar Tire Stores, to deal in tires. $250,000. Principal office, Wilmington, Delaware. Agent, Corporation Service Co., Wilmington, Delaware.

Atlantic and Pacific Tire Stores Association, to manufacture and deal in tires. $15,000. Incorporators: W. C. Maupin, Salisbury, N. Carolina; A. K. Buxton, Charlotte, N. Carolina; B. W. Culver, Macon, Georgia. Agent, United States Corporation.

Middletown Tire & Rubber Corporation, to manufacture tires. $5,000,000. Principal office, Wilmington, Delaware. Agent, Delaware Charter Co.

Kerwol Tire Stores Co., Inc., to manufacture and deal in tires, tubes, casings etc. $20,000. Incorporators: J. C. Wolf, 20 Pine street, Bradford, Pa.; H. J. Kernes, Bishop street, Bradford, Pa.; E. E. Wolf, 8 Tibbitts avenue, Bradford, Pa. Delaware Agent, Corporation Service Co., Equitable Building, Wilmington, Delaware.

Naugatuck Tire & Rubber Co., to manufacture and deal in tires and tubes. $1,500,000. Incorporators: C. B. Outten, S. L. Mackey and L. C. Christy—Wilmington,Delaware. Delaware Agent, Corporation Service Co., Equitable Building, Wilmington, Delaware.

ILLINOIS

Perfecton Tire Shop Inc., to deal in tires and tubes. $2,500. Incorporators: P. R. Simon, 521 East 49th street; V. E. Krajei, 2946 West 25th Place, M. R. Hartigan, 523 Englewood avenue— Chicago, Illinois. Principal office, Chicago, Illinois.

Illinois Rubber Co., Inc., to deal in tires. $1,000. Incorporators: J. E. Axtell, C. A. Winston—Chicago; C. L. Runyan, Terre Haute, Indiana. Principal office, 1140 South La Salle street, Chicago, Illinois.

MAINE

The Emergency Vulcanizing Co. $10,000. H. E. Porter, president; J. D. Maxwell, secretary; L. G. Hall, treasurer—Bangor, Maine. Principal office, Bangor, Maine.

MASSACHUSETTS

Universal Tire Sales & Repair Co., to repair and deal in tires. $50,000. A. H. Nicodemus, president; D. C. Gilliland, treasurer—Milton, Massachusetts. M. McLaughlin, secretary, 34 Webster street, Brookline Massachusetts. Principal office, Boston, Massachusetts.

NEW YORK

Ceasar Resilient Tire Corp., to manufacture and deal in tires. $200,000. Incorporators: P. Di Ceasar, C. Capria and J. Panagrosso. Attorney, F. J. Rinaldi, 167 East 121st street, New York City.

Dixon Rubber Co., to manufacture tires and rubber goods. $5,000. Incorporators: H. Rubakoff and E. I. Kleinfeld. Attorney, G. P. Branburger, 44 West 18th street, New York City.

Sumatra Rubber Specialties Co., to manufacture rubber goods. $5,000. Incorporators: C. and J. R. and H. D. Smith. Attorney, S. Fair, 291 Broadway, New York City.

Newport and Rosenthal, to manufacture tires. $5,000. Incorporators: R. Newport, C. F. Rosenthal and J. Rosenthal. Attorneys, Glueck & Degroot, 23 East 26th street.

Dexter Rubber Manufacturing Co., to manufacture accessories. $500. Incorporators: W. K. P. Bauman, E. H. Dexter and E. F. Dexter—of Gorhen, New York.

OHIO

Cut Rate Tire Co., to deal in tires and tubes. $25,000. Incorporators: R. Milier, I. Krulick, R. H. Everhard, M. B. Melchoir and W. Hirbrook. Principal office, Canton, Ohio.

Broughton Sales Co., to deal in tires and tubes. $25,000. Incorporators: E. W. Broughton, F. A. Palmer, C. E. Schoner, O. E. Wolf and S. A. Affleck. Principal office, 149 East Market street, Akron, Ohio.

Champion Rubber Co., to deal in rubber goods. $10,000. Incorporators: W. H. Stillwell, G. W. Cable and O. Wilcox. Principal office, Cuyahoga Falls, Ohio.

Fickel Brothers Tire Co., to manufacture rubber goods. 100 shares, no par value. Principal office, 1851 Euclid avenue, Cleveland, Ohio.

Western Rubber Mold Co., to deal in rubber supplies. $10,000. C. P. Raney, president; M. N. Crumbling, secretary and treasurer. Principal office, 913 South Main street, Akron, Ohio.

Niles Tire & Rubber Co., to manufacture rubber products. $10,000. Incorporators: F. E. Turrell, H. L. Smith, M. L. Merchant and J. M. Whitford. Principal office, Niles, Ohio.

Robbins & Founer Tire & Repair Co., to deal in tires. $10,000. Incorporators: G. W. Founer, L. A. Robbins and E. L. Bowen. Principal office, Canton, Ohio.

Youngstown Tire Manufacturing Co., to manufacture tires and rubber products. $10,000. Incorporators: O. C. Felson, D. I. Lynn, W. F. Judd and F. L. Jackson. Principal office, Youngstown, Ohio.

R. L. Robins Products Co., to manufacture rubber products. $15,000. Incorporators: S.J. Timmins, R. N. Tompkins, E. E. McCloud and K. W. Halsey. Principal office, Columbus, Ohio.

The 344 Tire Co., to deal in tires and tubes. $2,000. Incorporators: R. E. Sheets, K. M. Alsfauch, and J. G. Schmidt. Principal office, 1553 Gallia street, Portsmouth, Ohio.

TEXAS

Liberty Tire Co., to deal in tires. Capital stock, $5,000. Incorporators: W. P. Billingsley, W. H. Silvernail and R. A. Judd. Principal office, Beaumont, Texas.

WASHINGTON

The Occident Rubber Co., to deal in scrap rubber. $500,000. Principal office, Seattle, Washington.

Charles H. Harden & Co., to manufacture and deal in mechanical rubber goods etc. $20,000. Incorporators: Charles H. Harden and Robert R. Rossman. Principal office, Seattle, Washington.

Designation

Selfsealing Auto Tube Corporation, Delaware. 2500 shares preferred stock, $100 each; 6000 shares common stock, no par value. Representative, H. A. Sperry, 141 Broadway.

Name Change

Illinois Rubber Co. to Nuelle Rubber Co., Chicago.